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SEPTEMBER 2013

A FISHERY-INDEPENDENT SURVEY OF COWCOD *(SEBASTES LEVIS)* IN THE SOUTHERN CA BIGHT USING A REMOTELY OPERATED VEHICLE (ROV)

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U. S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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U. S. DEPARTMENT OF COMMERCE
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1. Abstract

Cowcod (*Sebastes levis*) are ecologically important members of the groundfish community off the United States (US) west coast. Adult cowcod preferentially inhabit deep (~70-500 m) rocky seabeds between Oregon (OR) and central Baja California, but are most common at depths from ~100-250 m between central California (CA) and the US-Mexico border (Love et al. 2002). Cowcod were once the target of recreational and commercial fisheries throughout central and southern CA (Lenarz 1986), but the fishery was declared overfished following the stock assessment by Butler et al. (1999). In 2000, the fishery was closed and several large (~11,000 km^2) area and depth closures, or Cowcod Conservation Areas (CCAs), were established to promote the rebuilding of these severely depleted populations.

Cowcod's affinity for deep, high-relief, rocky seabeds, which also support high densities of fragile, deep-water corals and sponges, precludes the use of traditional surveys methods such as SCUBA or swept-area benthic trawls. In 2002, a fishery-independent assessment of cowcod within the CCA was conducted using a line transect method from a manned submersible to establish baseline estimates of abundance and biomass (Yoklavich et al. 2007).

The goal of this study was to survey the majority of potential cowcod habitat in the southern CA Bight, between Pt. Conception, CA and the US-Mexico Border, both inside and outside the CCAs to: 1) examine population trends of cowcod since 2002; and 2) identify potential effects of the CCAs on the density and biomass of the cowcod population. Succinctly, this study used a remotely operated vehicle (ROV) to conduct a survey of cowcod habitats using a strip transect method (Buckland et al. 2001), with effort stratified by depth and seabed type. This project is also a central part of NOAA's Habitat Blueprint-Southwest Regional Initiative, which strives to "ensure healthy habitats to support sustainable fisheries, protected resources and coastal economies."

Visual strip transect surveys were conducted at offshore islands, banks, and seamounts throughout southern CA during several cruise legs that occurred between October and December 2012 using the Southwest Fisheries Science Center's (SWFSC's) high-definition high-voltage (HDHV) ROV aboard the 67-foot Commercial Passenger Fishing Vessel (CPFV) *Outer Limits*. The analysis of video data from the survey provided estimates of numbers, lengths, and seabed associations for all observed cowcod. The observed height-above-the-seabed and reaction to the ROV were also quantified for each cowcod observation.

Here we present descriptions of survey effort and preliminary estimates of encounter rates (km^{-1}), size distributions, depth distributions, and seabed associations.

A total of 167 transects traversing over 85 km were conducted at 18 sites throughout the SCB. Transects spanned depths from 67 to 268 m and encountered a variety of seabed types, from sandy or muddy and flat to high-relief, rocky and steeply sloping. A total of 189 cowcod were observed across all survey sites. Encounter rates varied greatly, however, by site, depth, and the dominant seabed lithology. Cowcod lengths ranged from 8.6 to 78.6 cm total length (*TL*). Two modes were apparent at 21-30 cm and 51-60 cm *TL* with the latter being the most frequent size range. In general, cowcod encounter rates were larger within the CCAs and lower outside, with the largest rate at The Kidney (5.8 km^{-1}) north of Santa Barbara Island. Encounter rates were largest in the 100-160 m depth stratum and in boulder and high-relief rock seabed types, and lowest in mud, sand, and pebble seabed types. Most cowcod were observed near the seabed and exhibited little or no reaction to the ROV. Notes from each transect at each site are detailed in the **Survey Log** section at the end of this report.

2. Introduction

Cowcod (*Sebastes levis*) are ecologically important members of the groundfish community off the United States (US) west coast. Adult cowcod preferentially inhabit deep (~70-500 m) rocky seabeds between Oregon (OR) and central Baja California, but are most common at depths from ~100-250 m between central California (CA) and the US-Mexico border(Love et al. 2002). Young-of-the-year and juvenile cowcod often recruit to shallow, low-relief areas and then migrate, as they age, to deep-water rocky reefs. Cowcod are long-lived (maximum age ≥ 55 years, Love et al. 1990) and late to mature (~10 years old at 50% maturity, Love et al. 1990), and are therefore particularly prone to over exploitation.

Cowcod was once the target of recreational and commercial fisheries throughout central and southern CA (Lenarz 1986), but the fishery was declared overfished following the stock assessment by Butler et al. (1999). In 2000, the fishery was closed and several large (~11,000 km^2) area and depth closures, or Cowcod Conservation Areas (CCAs), were established to promote the rebuilding of these severely depleted populations. The rebuilding time for cowcod with no fishing mortality (F = 0) was estimated to be approximately 90 years (Butler et al. 2003).

The cowcod's affinity for deep, high-relief, rocky seabeds, which also support high densities of fragile deep-water corals and sponges, precludes the use of traditional surveys methods such as SCUBA or swept-area benthic trawls. In 2002, a fishery-independent assessment of cowcod was conducted using a line transect method from a manned submersible to establish baseline estimates of abundance and biomass within the CCAs following their creation (Yoklavich et al. 2007). These estimates were used by Dick et al. (2009) as relative indices in the latest cowcod stock assessment (http://www.pcouncil.org/wp-content/uploads/cowcod_update_assessment_2009.pdf). No additional fishery-independent data about the status of cowcod stocks have been collected since 2002.

The goal of this study was to survey the majority of potential cowcod habitat in the southern CA Bight, between Pt. Conception, CA and the US-Mexico Border, both inside and outside the CCAs to: 1) examine population trends of cowcod since 2002; and 2) identify potential effects of the CCAs on the density and biomass of the cowcod population. Succinctly, this study used a remotely operated vehicle (ROV) to conduct a survey of cowcod habitats using a strip transect method (Buckland et al. 2001), with effort stratified by depth and seabed type. This project is also a central part of NOAA's Habitat Blueprint-Southwest Regional Initiative, which strives to "ensure healthy habitats to support sustainable fisheries, protected resources, and coastal economies."

3. Methods

3.1 Survey overview

Visual strip transect surveys were conducted at offshore islands, banks, and seamounts throughout southern CA during several cruise legs that occurred between October and December 2012 (**Figure 1**): Leg 1 (10-21 October), Leg 2 (29 October- 2 November), Leg 3 (4-8 November), and Leg 4 (8-13 December). The survey was conducted during a total of 28 days contracted with the 67-foot Commercial Passenger Fishing Vessel (CPFV) *Outer Limits*. Time lost to poor weather and consumed by transits between sites totaled two survey days, netting 26 days of ROV surveys.

3.2 Survey platforms

Underwater visual transect surveys were conducted using the Southwest Fisheries Science Center's (SWFSC's) high-definition high-voltage (HDHV) ROV aboard *Outer Limits*. High-definition (1080

lines of resolution, interlaced, or 1080i) video was recorded to digital-video tape and also on computer hard drives. These were later used for enumerating fishes, describing their behavior, and characterizing the seabed. To aid in the identification and measurement of fishes observed on the video tapes, and also for better characterizing seabeds, nearly 3,000 high-quality digital still images were also captured.

The three-dimensional (3-D) location of the ROV was estimated using an ultra-short baseline (USBL) acoustic tracking system (TrackLink 1500HA, LinkQuest, Inc.) and differential global positioning system (dGPS, CSI Wireless dGPS MAX). The length of each transect was estimated from the speed of the ROV, which was measured using a Doppler velocity log (DVL, Workhorse Navigator, Teledyne RD Instruments). Water quality parameters (e.g., temperature, salinity, dissolved oxygen (DO) concentration and percent DO saturation) near the seabed were measured during each transect using a CTD (Citadel CTD-ES, Teledyne RD Instruments) and oxygen optode (Model 3930, Aanderaa, Inc.). All data were time-stamped and logged synchronously using WinFrog integrated navigation software (Fugro Pelagos, Inc.). Two pairs of reference lasers (spaced 20 and 40 cm apart, respectively) were used to estimate the length of each cowcod and the width of each transect. A new method for calculating search area from the pitch and altitude of the camera is being developed that could more easily provide accurate estimates of search effort. All navigation, photo, and video data are archived in the SWFSC Benthic Resources Group's SQL Server database (ROV2).

3.3 Sampling design

A stratified-random survey was conducted at each of the survey locations in **Figure 1**. Cowcod habitat was deemed to be areas of partly- to entirely-hard seabed between the depths of 70 and 300 m. A variety of data sources were used to identify potential cowcod habitat, based on the seabed geology, including: multibeam bathymetric maps and interpreted seabed maps (Goldfinger et al. 2007), preliminary unsupervised seabed classifications from multi-frequency, split-beam acoustic surveys (G. Cutter and D. Demer, unpublished data), and seabed observations from previous ROV surveys (K. Stierhoff, unpublished data) (**Figure 2**).

The amount of effort at each site was determined by the size of the area, with a minimum of one day allocated to each site. For example, two and three days were allocated to Cortes Bank and San Nicolas Island, respectively. The amount of effort within each depth strata at each site was determined using an empirical cumulative distribution function (ECDF) of cowcod encounter rates by depth from previous surveys of cowcod using the SWFSC's Phantom DS4 ROV (Deep Ocean Engineering, Inc.). The 25th, 50th, and 75th percentiles of cowcod encounter rates occurred at approximately 100, 125, and 160 m, respectively (**Figure 3**). Estimated *a priori*, as many as ten, approximately 30 minute or 500 m ROV transects could be conducted each day during daylight hours (~06:30 to 17:00 h PST). Transect-start or -end points were selected at random within each depth and seabed type strata (**Figure 3**). To minimize uncertainty in the density estimates, the number of transects were allocated so that slightly more samples occurred in areas where cowcod densities were expected to be greatest (i.e., areas 100 and 160 m depth with high probability of rock).

3.4 Effort analysis

The target transect length for each transect was approximately 500 m. The actual length of each transect was calculated from the speed of the ROV, as measured by the DVL. Distances calculated using this method are accurate to ~±1% (Stierhoff et al. In prep.). Area searched estimates will be estimated every 20 s from the reference lasers using photogrammetric software (3Beam v5.0, Kocak et al. 2002, Pinkard et al. 2005, Stierhoff et al. 2012).

3.5 Video analysis

The primary focus of the video analysis was to provide counts, length estimates, and seabed associations for all observed cowcod. The observed height-above-the-seabed and behavioral reaction to the ROV were also quantified for each cowcod observation.

3.5.1 Length estimation

For each cowcod observation, total length (*TL*; cm) was estimated to the nearest 10 cm (e.g., 0-10 cm, 10-20 cm, etc.) using the 20- or 40-cm parallel reference lasers. When cowcod were oriented normal to the lens of the camera and near the reference lasers, video snapshots were taken to more precisely measure *TL* using an open-source image analysis package (ImageJ, National Institute of Health). Estimates of *TL* from the image analysis software were possible for most cowcod observed. For those where laser measurements were not possible, the midpoint of the 10-cm size class was used to estimate biomass.

3.5.2 Seabed classification and association

Following the method of Stein et al. (1992), primary (>50% of the seabed within the strip area) and secondary (20-50% of the seabed within the strip area) seabed lithology was described at the beginning of the transect, at the time of each fish observation, and also at any transition between different seabed types, allowing for the description of associations between each species and different seabed types and also the estimation of area searched within each seabed type. The description of seabed lithology followed the classification scheme of Greene et al. (1999) based on particle size: mud (clay to silt; <0.06 mm), sand (0.06-2 mm), pebble (2-64 mm), cobble (64-256 mm), boulder (0.25-3 m), low-complexity (<0.25 m vertical relief; e.g., pavement) reef, and high-complexity (>0.25 m vertical relief) reef. The term "complexity" refers to the presence and the size of cracks and crevices in the seabed that may provide refuge to cowcod. Based on the size and shape of these features, low-complexity and high-complexity reef probably serve the same ecological function as sand/pebble and cobble/boulder, respectively.

3.5.3 Fish height-above-the-seabed

The observed height of each fish above the seabed was also estimated. The observed height was classified as either "on" (i.e., in contact with) or "in" the seabed (i.e., under rocks or within rock crevices), or categorized based on the observed height above the seabed (0.1-0.5 m, 0.5-1.0 m, 1-2 m, 2-3 m, or >3 m). The ROV typically surveyed close to the seabed (average altitude = 1.17 m) with the camera oriented slightly below horizontal (average pitch = 23° below horizontal), so most observations occurred within ~2 m of the seabed.

3.5.4 Reaction to the ROV

The observed reaction of each cowcod to the ROV was also recorded. A reaction is considered to be an alteration in fish behavior (generally a change in direction or speed) that occurred between the time when the fish was first visible and when a positive identification was possible. In this sense, a reaction could potentially bias (either positively or negatively) optically-estimated abundances and biomasses. Observed reactions were classified as: no reaction, lateral movement (either toward or away from the center of the camera field-of-view (FOV), or forward ahead of the ROV), vertically (toward or away from the seabed), or down and horizontal (e.g., individuals swimming toward the seabed and away from the center of the camera FOV).

3.5.5 Abundance and biomass estimation

The total abundance and biomass of cowcod were estimated at each site. Total abundance (N) in each transect was estimated using the strip transect method (Buckland et al. 2001) by multiplying the density of each species (D) within a stratum by the total area (A) within that stratum. Density was calculated as:

$$D = \frac{n}{a} \quad (1)$$

where n is the number of individuals encountered during the transect, and a is the area searched in each transect length. The total area of each depth stratum was estimated using ArcGIS. The biomass (B) for each species was estimated from the length-weight relationship described by Love et al. (1990):

$$B = 0.0101 * TL^{3.0933} \quad (2)$$

where TL is estimated using reference lasers. The mean, coefficient of variation (CV) of the mean, and the 90th-quantiles for abundance and biomass were estimated using a non-parametric bootstrap of 1,000 samples (Efron & Tibshirani 1993).

3.6 Statistical analysis

All statistical analyses were conducted using R (R Development Core Team 2011). All figures were produced using the R package 'ggplot2' (Wickam 2009). All maps were produced using ArcGIS v10 (ESRI, Inc.).

4. Preliminary Results

Below, we describe the survey effort and some preliminary estimates of cowcod encounter rates, size distributions, depth distributions, and seabed associations.

4.1 Survey effort

A total of 167 transects traversing over 85 km were conducted at 18 sites throughout the SCB. Estimates of transect width have not yet been calculated, and therefore, search area is presently unavailable. Transects spanned average depths of 67 to 268 m (**Table 1**) and encountered a variety of seabed types, from sandy or muddy and flat to high-relief, rocky and steeply sloping (**Table 2**). Very little sampling was conducted at the 117 Seamount and at 60 Mile Bank due to technical difficulties and poor weather, respectively. Therefore, abundances and distributions will not be estimated for those sites.

4.2 Cowcod observations

A total of 189 cowcod were observed throughout all survey sites. Encounter rates varied greatly by site, depth, and the dominant seabed lithology.

4.2.1 Geographic distribution

The numbers and encounter rates of cowcod varied greatly by site. The largest number of cowcod were observed at The Kidney (n=35), just north of Santa Barbara Island (**Figure, 4, Table 3**). Encounter rates ranged from 0.4-5.8 cowcod km^{-1}, with the largest encounter rates at The Kidney and Lasuen Knoll between Santa Catalina Island and the CA mainland coast (**Figure 4, able 3**). No cowcod were observed at 60 Mile Bank.

4.2.2 Length distribution

Cowcod TL ranged from 8.6 to 78.6 cm. Two modes were apparent: 21-30 cm and 51-60 cm. The latter was the most frequent size class (**Figure 5**).

4.2.3 Habitat associations

Cowcod encounter rates (km^{-1}) were greatest in the boulder (B) and high-relief rock (H) seabed types, and least abundant in mud, sand, and pebble seabed types (**Figure 6**).

4.2.4 Depth distribution

Cowcod encounter rates (km^{-1}) were greatest in the 100-160 m depth stratum, lower in the 70-100 m depth stratum, and lowest in the 160-300 m stratum (**Figure 7**). Sampling effort was also greatest between 100-160 m, and encounter rates were not normalized relative to survey effort in each depth stratum.

4.2.5 Height above the seabed

In the presence of the ROV, most (79%, n = 149) of the cowcod were observed either on or within 0.5 m of the seabed (**Figure 8**). The frequency of observations (not normalized by effort) decreased with increased height above the seabed; and all observed cowcod were within 3 m of the seabed (**Figure 8**).

4.2.6 Reaction to the ROV

Most (78%, n = 147) cowcod were not observed reacting to the observing ROV (**Figure 9**). Note, however, that fish reactions may occur outside of the FOV. Of the 22% (n = 42) that were observed reacting to the ROV, approximately 12% moved into, or down toward the center of the FOV (attraction) and 10% moved up or outward and away from the center of the FOV (avoidance), respectively, potentially biasing estimates of abundance (**Figure 9**).

5. Acknowledgements

This survey would not have been possible without the technical and logistical support of Scott Mau, David Murfin, Ken Franke, Capt. Paul Fischer, and the crew of the CPFV *Outer Limits*. We would also like to thank Kirk Sato and Emily Bell for volunteering their time to assist on the cruise. David Murfin and Scott Mau reviewed video tapes for verifying cowcod observations and describing behavior. Scott Mau captured screen grabs to measure cowcod. David Demer provided valuable suggestions that improved earlier drafts of this report. Funding for this project was provided by the NOAA Cooperative Fisheries Program.

6. Tables

Table 1. Summary of survey distance (km) within each depth stratum at each site.

	Depth			
Site name	**<100 m**	**100-160 m**	**130-300 m**	**All**
117 Seamount	0.00	0.00	0.93	0.93
43 Fathom Bank	1.27	1.66	2.46	5.39
60 Mile Bank	0.05	0.97	0.00	1.01
9 Mile Bank	0.00	3.13	1.54	4.67
Cherry Bank	0.09	3.64	0.56	4.29
Cortes Bank	1.61	5.20	1.46	8.27
Cortes Spawning Grounds	0.00	3.21	1.37	4.58
Hidden Reef	0.28	1.99	1.05	3.32
Lasuen Knoll	0.07	2.90	0.00	2.97
Mission Beach Reef	1.58	1.38	0.00	2.96
Osborne Bank	1.51	2.37	0.48	4.37
Potato Bank	1.52	3.38	0.25	5.14
San Clemente Island	2.12	4.19	1.38	7.68
San Nicolas Island	3.24	6.83	2.33	12.40
Santa Barbara Island	0.91	2.06	1.17	4.14
Santa Catalina Island	1.23	0.90	0.43	2.57
Tanner Bank	1.62	2.07	0.94	4.63
The Kidney	0.00	4.11	1.94	6.05
All	17.11	49.99	18.28	85.38

Table 2. Summary of survey distance (km) within each primary lithology type at each site. Primary lithology is sorted from smallest to largest grain size, and generally follow the classification scheme of Greene et al. (1999).

	Primary lithology							
Site name	**Mud**	**Sand**	**Pebble**	**Cobble**	**Low rock**	**Boulder**	**High rock**	**All**
117 Seamount	-	-	-	0.11	-	0.81	0.01	0.93
43 Fathom Bank	-	3.13	0.06	0.96	0.04	0.61	0.59	5.39
60 Mile Bank	-	0.33	-	-	-	0.23	0.45	1.01
9 Mile Bank	0.80	2.19	-	0.32	0.03	1.32	0.02	4.67
Cherry Bank	-	0.66	0.04	1.67	0.04	1.33	0.55	4.29
Cortes Bank	-	4.11	-	0.70	0.56	1.76	1.13	8.27
Cortes Spawning Grounds	-	1.36	0.07	2.01	0.02	1.10	0.02	4.58
Hidden Reef	-	1.26	-	0.01	0.46	0.11	1.47	3.32
Lasuen Knoll	-	1.04	-	-	0.01	1.93	-	2.97
Mission Beach Reef	2.55	0.41	-	-	-	-	-	2.96
Osborne Bank	-	2.29	-	0.13	0.17	0.69	1.08	4.37
Potato Bank	-	0.86	-	0.19	0.34	2.96	0.79	5.14
San Clemente Island	-	5.89	0.09	-	0.14	0.33	1.23	7.68
San Nicolas Island	0.31	3.60	0.82	2.38	1.58	3.48	0.21	12.40
Santa Barbara Island	-	1.64	0.16	0.45	0.07	1.27	0.55	4.14
Santa Catalina Island	-	1.53	-	0.12	-	0.10	0.83	2.57
Tanner Bank	0.44	2.74	-	0.04	0.51	0.53	0.38	4.63
The Kidney	0.02	1.28	-	0.76	0.06	3.78	0.15	6.05
All	4.11	34.32	1.24	9.84	4.03	22.36	9.47	85.38

Table 3. Summary of cowcod (*Sebastes levis*) observations and encounter rates (cowcod km^{-1}) at each survey site in the Southern California Bight.

Site name	Latitude	Longitude	Distance	Cowcod	Encounter rate
117 Seamount	33.5490	-119.2082	0.93	1	1.1
43 Fathom Bank	32.6537	-117.9703	5.39	11	2.0
60 Mile Bank	32.0753	-118.2500	1.01	0	0.0
9 Mile Bank	32.6113	-117.4037	4.67	6	1.3
Cherry Bank	32.8925	-119.4377	4.29	10	2.3
Cortes Bank	32.5522	-119.3069	8.27	17	2.1
Cortes Spawning Grounds	32.6113	-119.1942	4.58	15	3.3
Hidden Reef	33.7315	-119.1668	3.32	12	3.6
Lasuen Knoll	33.3983	-117.9986	2.97	17	5.7
Mission Beach Reef	32.7907	-117.3665	2.96	2	0.7
Osborne Bank	33.3657	-119.0520	4.37	14	3.2
Potato Bank	33.2617	-119.8361	5.14	6	1.2
San Clemente Island	32.8382	-118.5059	7.68	4	0.5
San Nicolas Island	33.3872	-119.6945	12.40	13	1.0
Santa Barbara Island	33.5053	-119.0939	4.14	15	3.6
Santa Catalina Island	33.4714	-118.6255	2.57	1	0.4
Tanner Bank	32.6765	-119.0954	4.63	15	3.2
The Kidney	33.6050	-119.0854	6.05	35	5.8
All sites			85.4	194	

7. Figures

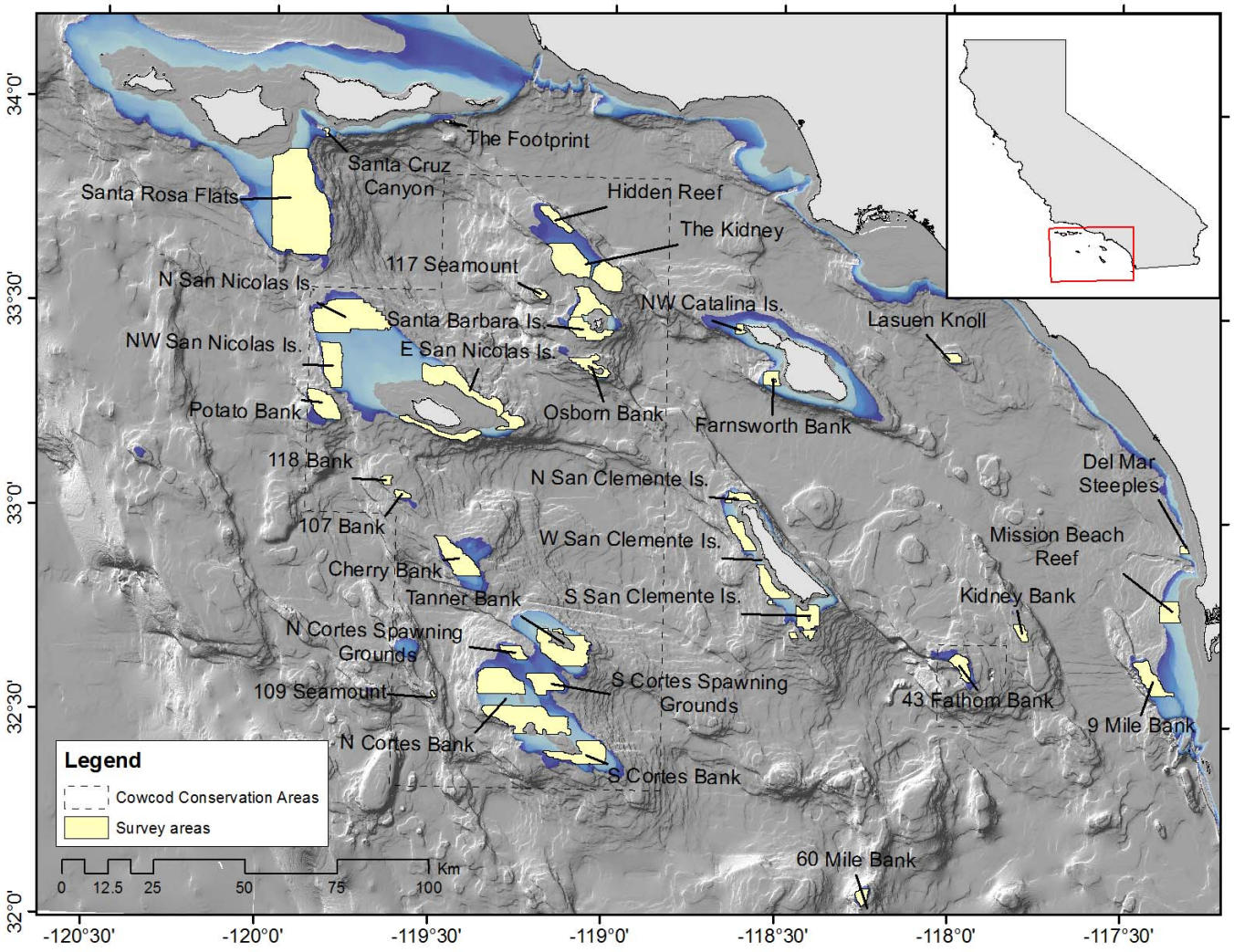

Figure 1. Map of the 2012 Southern CA Bight Cowcod Survey area. Blue shaded areas indicate regions of the seabed within the expected depth range of cowcod habitats (70-300 m). Yellow shaded areas indicate areas where surveys were conducted. The Cowcod Conservation Areas are indicated by the dashed box.

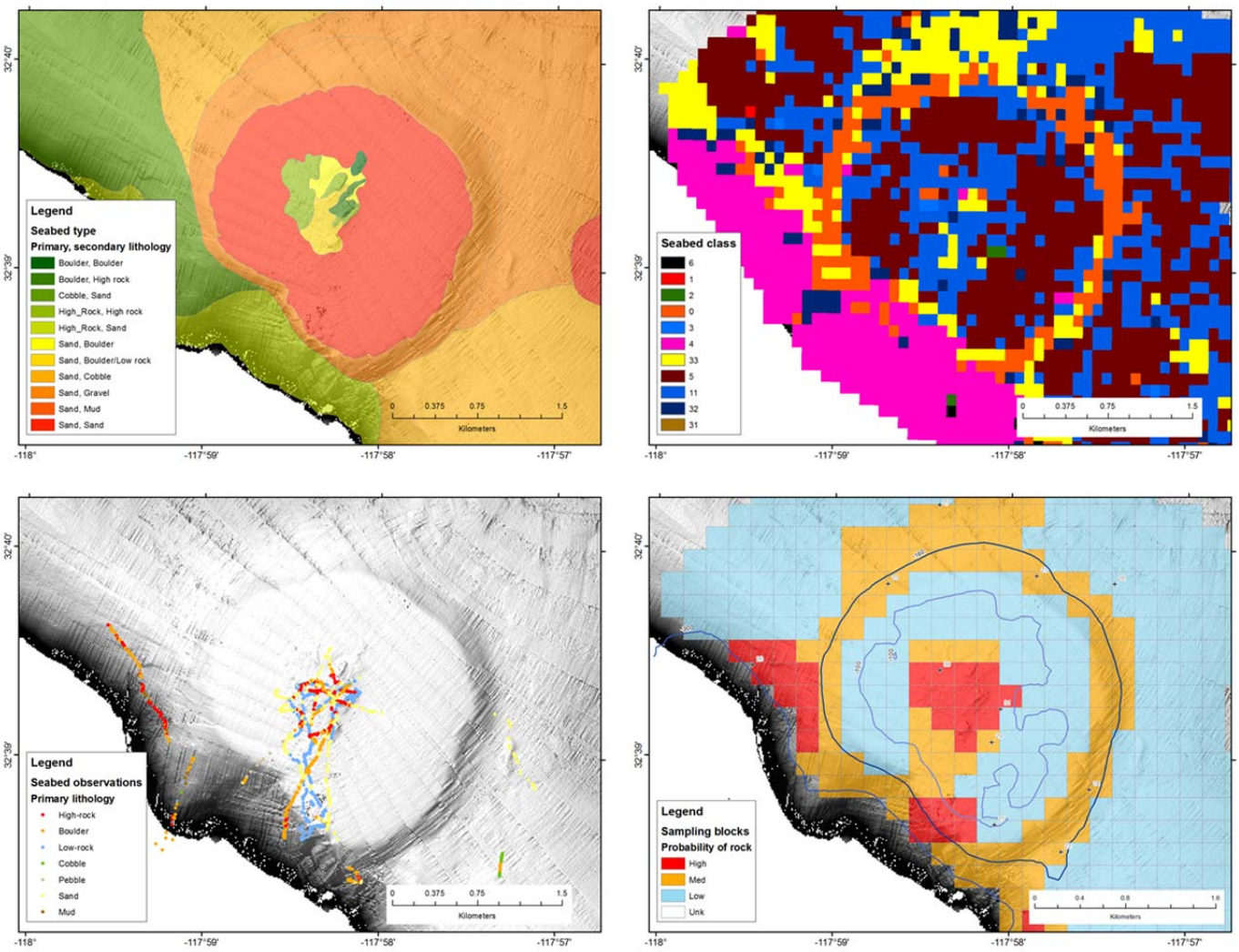

Figure 2. Examples of data used to identify potential habitat of cowcod (*Sebastes levis*) at 43 Fathom Bank: Interpreted seabed lithology (upper left), unsupervised acoustic classification (upper right), observations from a remotely operated vehicle (ROV, lower left). The probability of rocky substrate was described as high, medium or low within a 200x200 m grid (lower right). Random transect locations were selected from each depth strata and primarily in areas with high or low probability of rock (numbered crosses, lower right).

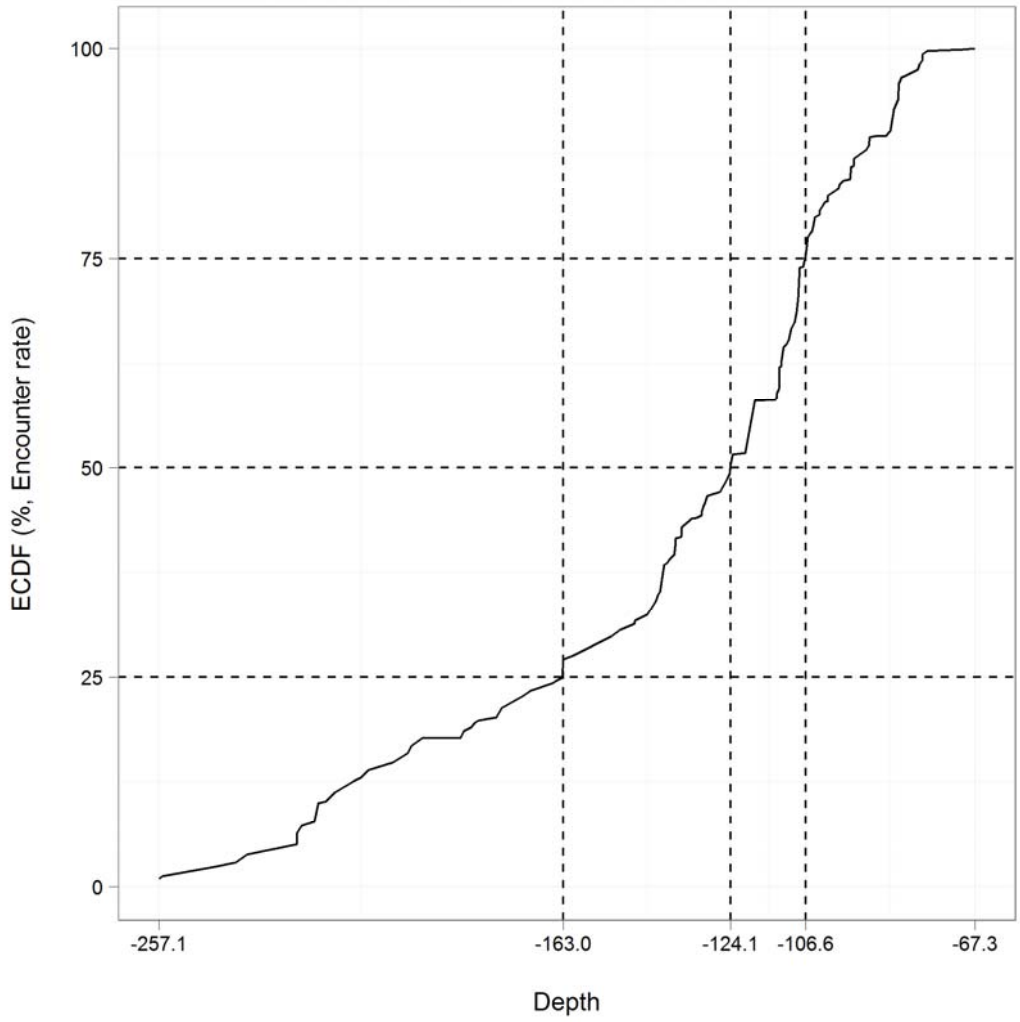

Figure 3. The empirical cumulative distribution function (ECDF) of cowcod (*Sebastes levis*) encounter rates (# of individuals per unit distance) by depth from previous remotely operated vehicle surveys. The quartiles of the distribution and their corresponding depths are indicated by the dashed lines.

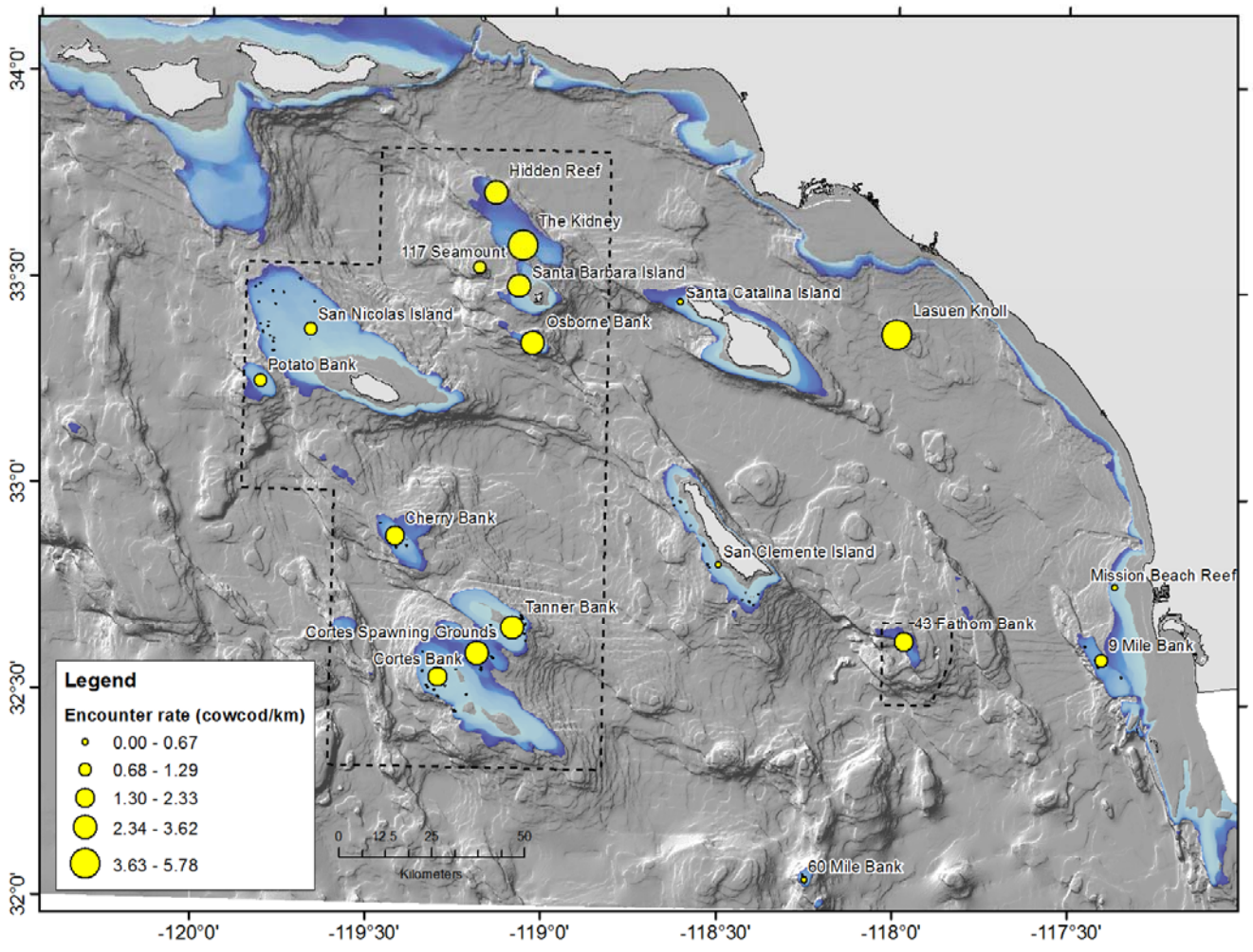

Figure 4. Encounter rate of cowcod (*Sebastes levis*, km^{-1}) at each site throughout the Southern CA Bight.

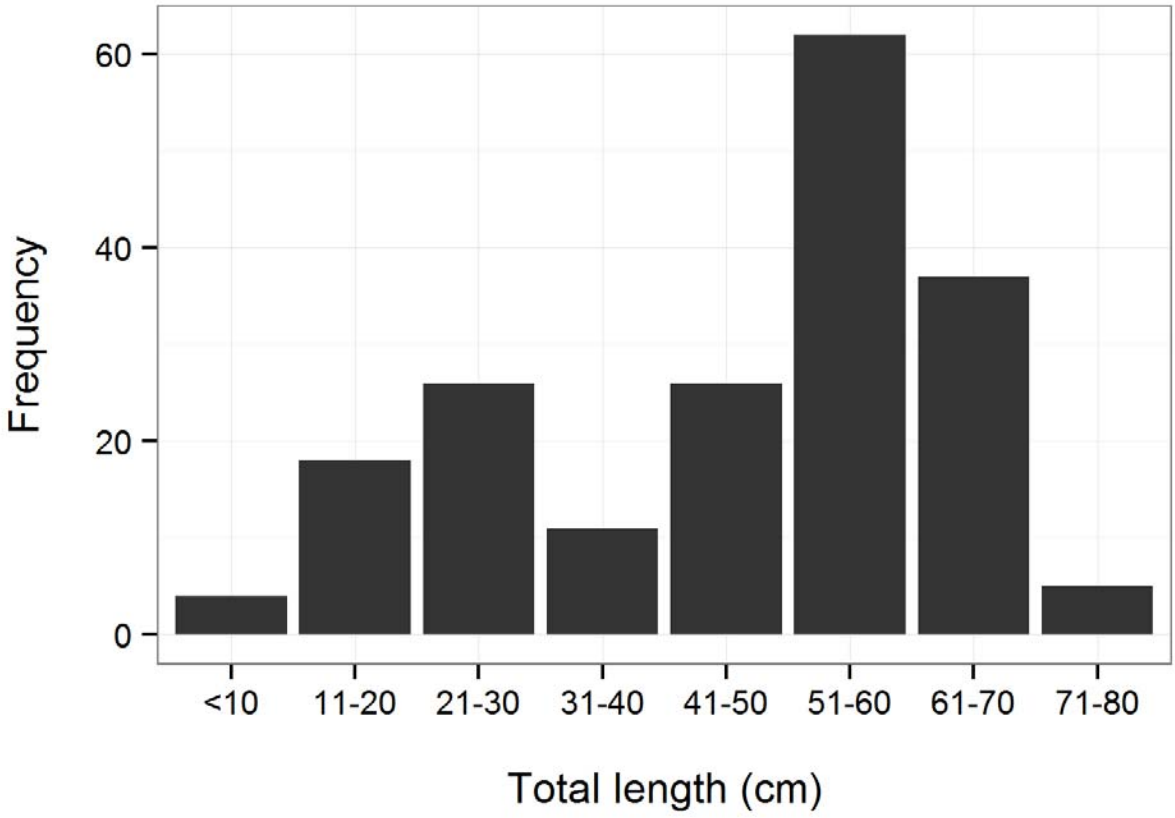

Figure 5. Length distribution of cowcod (*Sebastes levis*, cm) observed throughout the Southern CA Bight survey area.

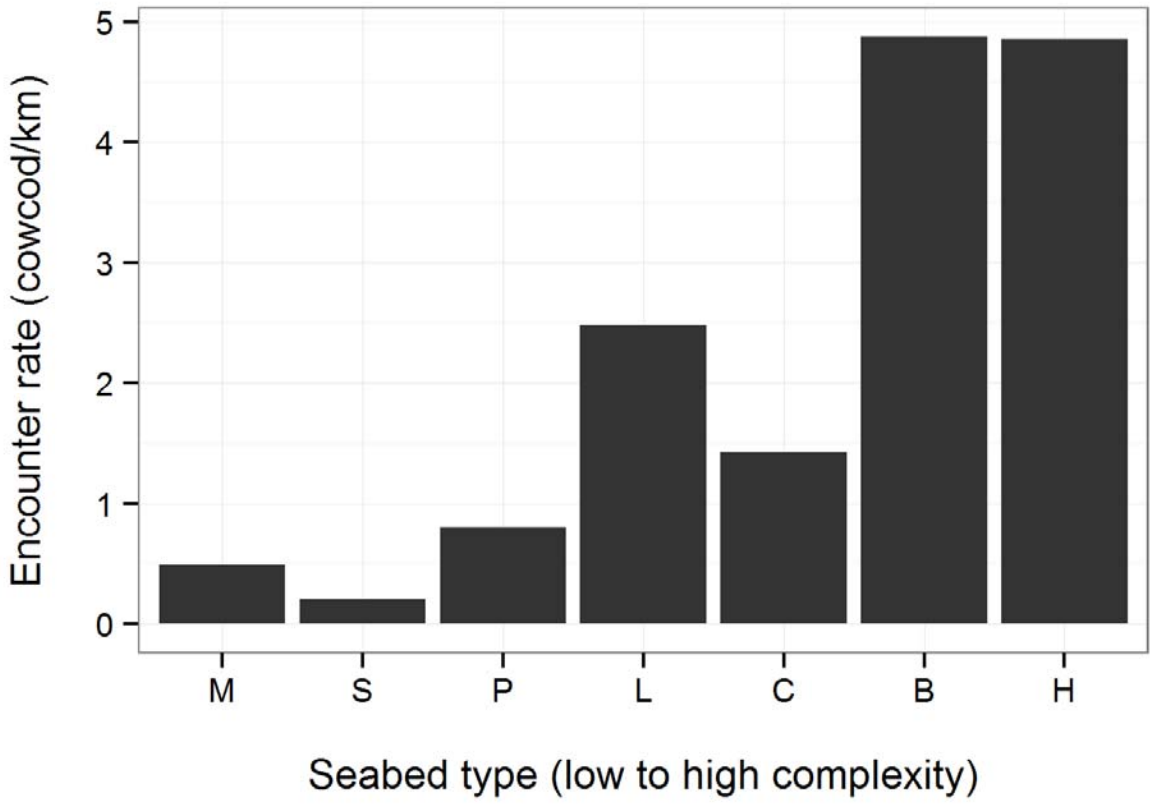

Figure 6. Encounter rate of cowcod (*Sebastes levis*, km^{-1}) observed throughout the Southern California Bight survey area. Seabed types are ranked from smallest to largest grain size: mud (M), sand (S), pebble (P), low-relief rock (L), cobble (C), boulder (B), and high-relief rock (H).

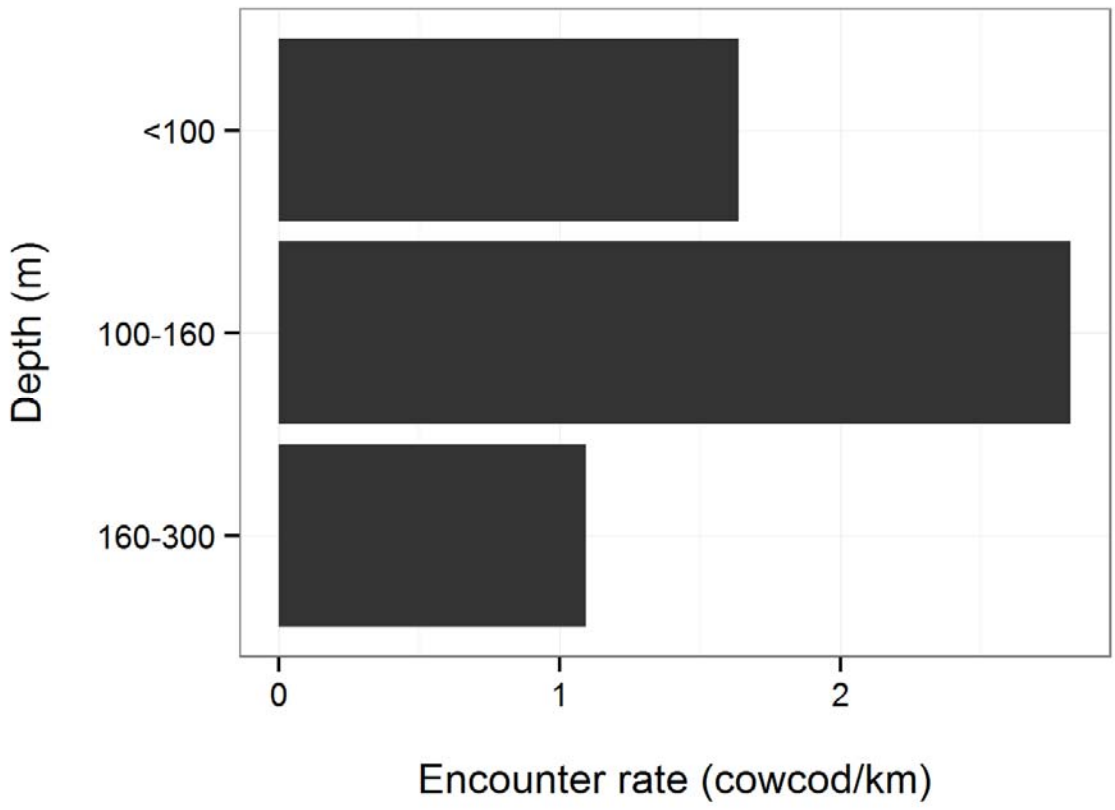

Figure 7. Encounter rate of cowcod (*Sebastes levis*, km^{-1}) by depth throughout the Southern CA Bight survey area.

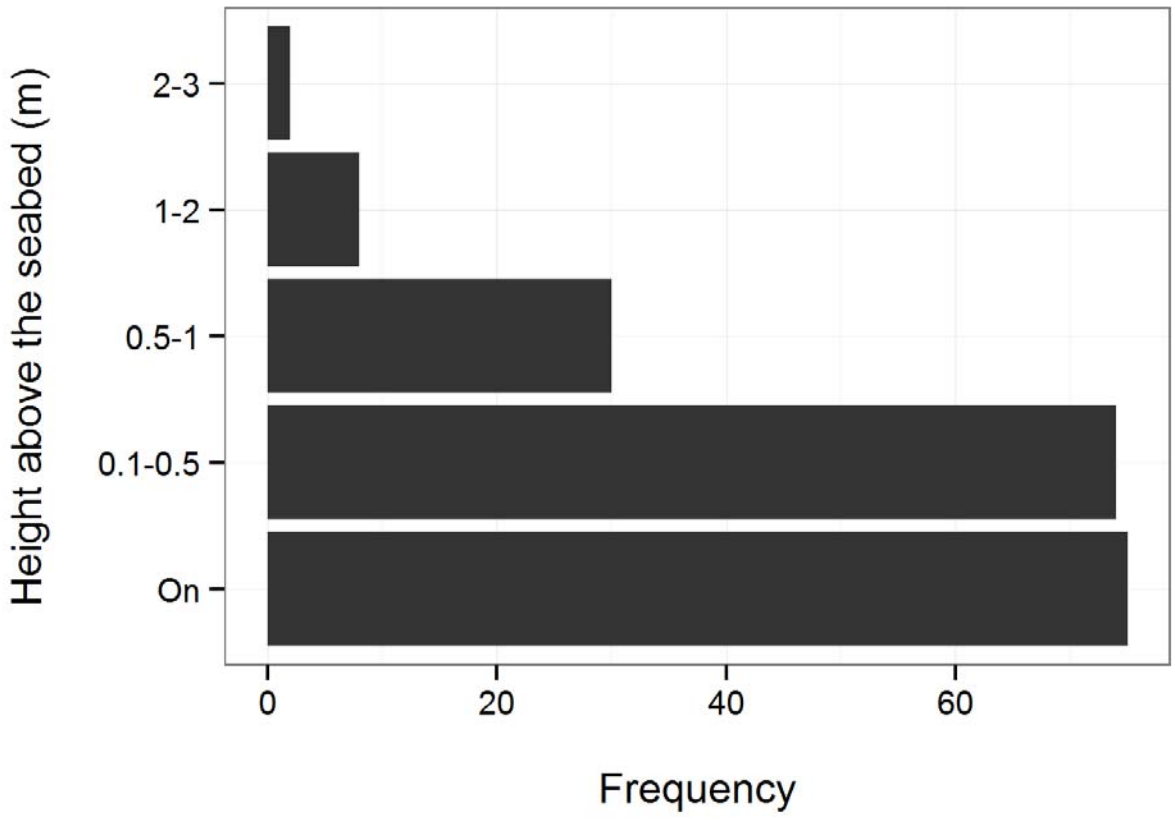

Figure 8. Observed height (m) of cowcod (*Sebastes levis*) above the seabed.

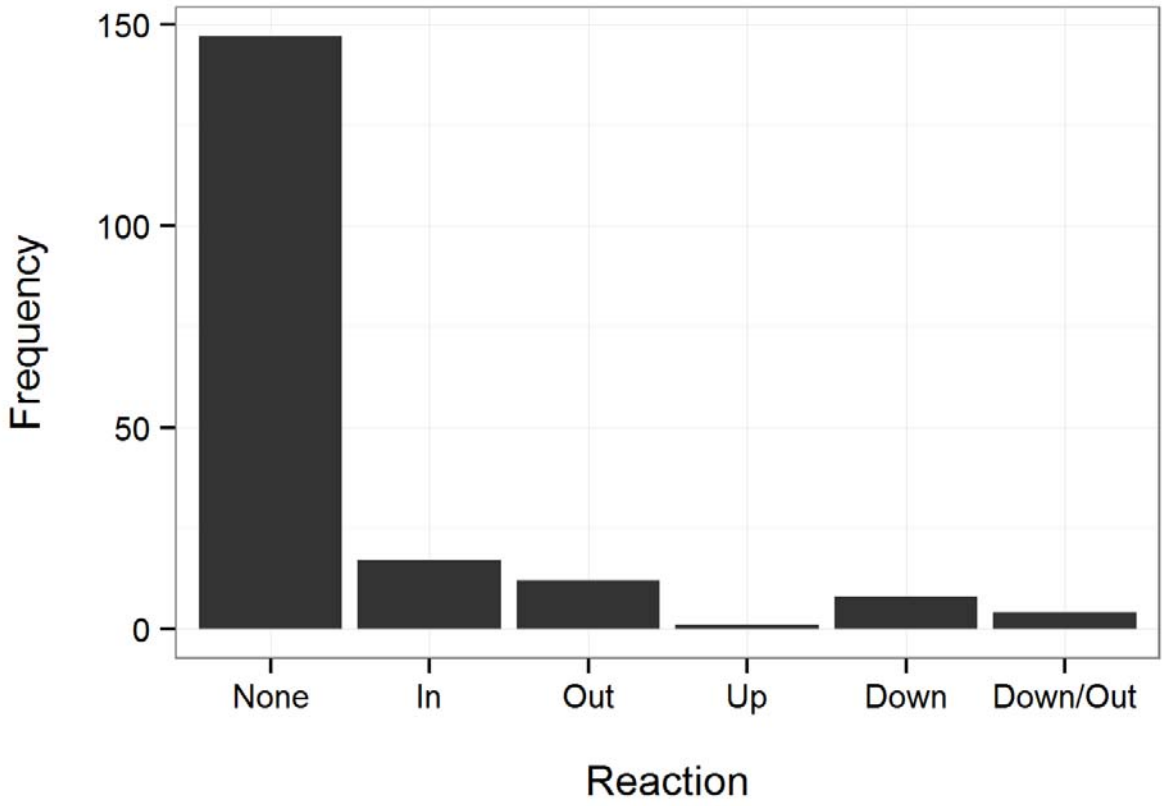

Figure 9. Observed reactions of cowcod (*Sebastes levis*) to the remotely operated vehicle (ROV).

8. Cruise participants

8.1 Scientific party

Leg 1 (October 10-21, 2012)

Member	Role	Affiliation
Kevin L. Stierhoff, PhD	Fisheries Biologist, Chief Scientist	NOAA/NMFS/SWFSC
Scott A. Mau	Fisheries Biologist	NOAA/NMFS/SWFSC
David W. Murfin	Engineer	NOAA/NMFS/SWFSC
Leslie Wickes	Graduate Student	College of Charleston

Leg 2 (October 29-30, 2012)

Member	Role	Affiliation
Kevin L. Stierhoff, PhD	Fisheries Biologist, Chief Scientist	NOAA/NMFS/SWFSC
Scott A. Mau	Fisheries Biologist	NOAA/NMFS/SWFSC
David W. Murfin	Engineer	NOAA/NMFS/SWFSC
Kirk Sato	Graduate Student	UCSD, Scripps Inst. Oc.

Leg 3 (November 4-8, 2012)

Member	Role	Affiliation
Kevin L. Stierhoff, PhD	Fisheries Biologist, Chief Scientist	NOAA/NMFS/SWFSC
Scott A. Mau	Fisheries Biologist	NOAA/NMFS/SWFSC
David W. Murfin	Engineer	NOAA/NMFS/SWFSC

Leg 4 (December 8-13, 2012)

Member	Role	Affiliation
Kevin L. Stierhoff, PhD	Fisheries Biologist, Chief Scientist	NOAA/NMFS/SWFSC
Scott A. Mau	Fisheries Biologist	NOAA/NMFS/SWFSC
Emily Bell	Undergraduate Volunteer	UC Berkeley

8.2 Crewmembers

Member	Role	Affiliation
Paul Fischer	Captain	CPFV *Outer Limits*
Steve Kudota	Captain	CPFV *Outer Limits*
Justin Kaufman	Crewmember	CPFV *Outer Limits*
Art Hill	Crewmember	CPFV *Outer Limits*

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10. Survey log

Notes and observations include sea conditions, seabed description, species and marine debris observations, and ROV performance. All times are in UTC.

10.1 Leg 1 (October 10-21, 2012)

Day 1: Mission Beach Reef
Start date: 10/10/2012 (Wed)

15:30 Conducted ROV trials and crew training at the Mission Bay bait barge. With the ROV in the water, the high-definition (HD) video is experiencing lots of flickering. The rear facing light was removed and the flickering subsided upon redeployment. The current draw by the light may have exceeded the capacity of the Vicor power supply. Next time we open the electronics bottle, the light should be wired to the auxiliary power supply. The ROV trim is ~5 lbs. positive.

16:00-16:45 Transit to Mission Beach Reef.

17:15-00:15 (10/11/2012) Surveyed Mission Beach Reef (**Figure 7**).

Dive name: 12-284A (Point 168)
Start time: 17:15 **End time:** 18:00
Notes: Calm Seas, poor visibility, Mud Bottom. HD video flickered a few times and this is thought to be from "turns" in the umbilical. Camview CCI files were not recorded for this transect.
Observations: No *S. levis*

Dive name: 12-284B (Point 160)
Start time: 18:57 **End time:** 19:24
Notes: Calm Seas, poor visibility, Mud Bottom. The video did not flicker on this transect after removing turns from the umbilical. Two longlines and one Net were found. Mostly sand and urchins.
Observations: No *S. levis*

Dive name: 12-284C (Point 161)
Start time: 20:13 **End time:** 20:46
Notes: Calm Seas, poor visibility, Mud Bottom. More sand and urchins here.
Observations: No *S. levis*

Dive name: 12-284D (Point 162)
Start time: 21:00 **End time:** 21:29
Notes: Seas are calm. Visibility is poor, but better than previous transects. Mud/sand bottom.
Observations:
21:04 Juvenile *S. levis*

Dive name: 12-284E (Point 163)
Start time: 22:14 **End time:** 22:46
Notes: Wind ~10 kt. 0.5-1 m swell. Visibility is decent. More mud/sand.
Observations: No *S. levis*

Dive name: 12-284F (Point 167)
Start time: 23:39 **End time:** 00:19
Notes: Winds ~10 kt. 0.5-1 m swell. Visibility is decent. More mud/sand.
Observations:
00:14 Juvenile *S. levis*

**All is well with the ROV. Transiting to Osborn Bank south of Santa Barbara Island.

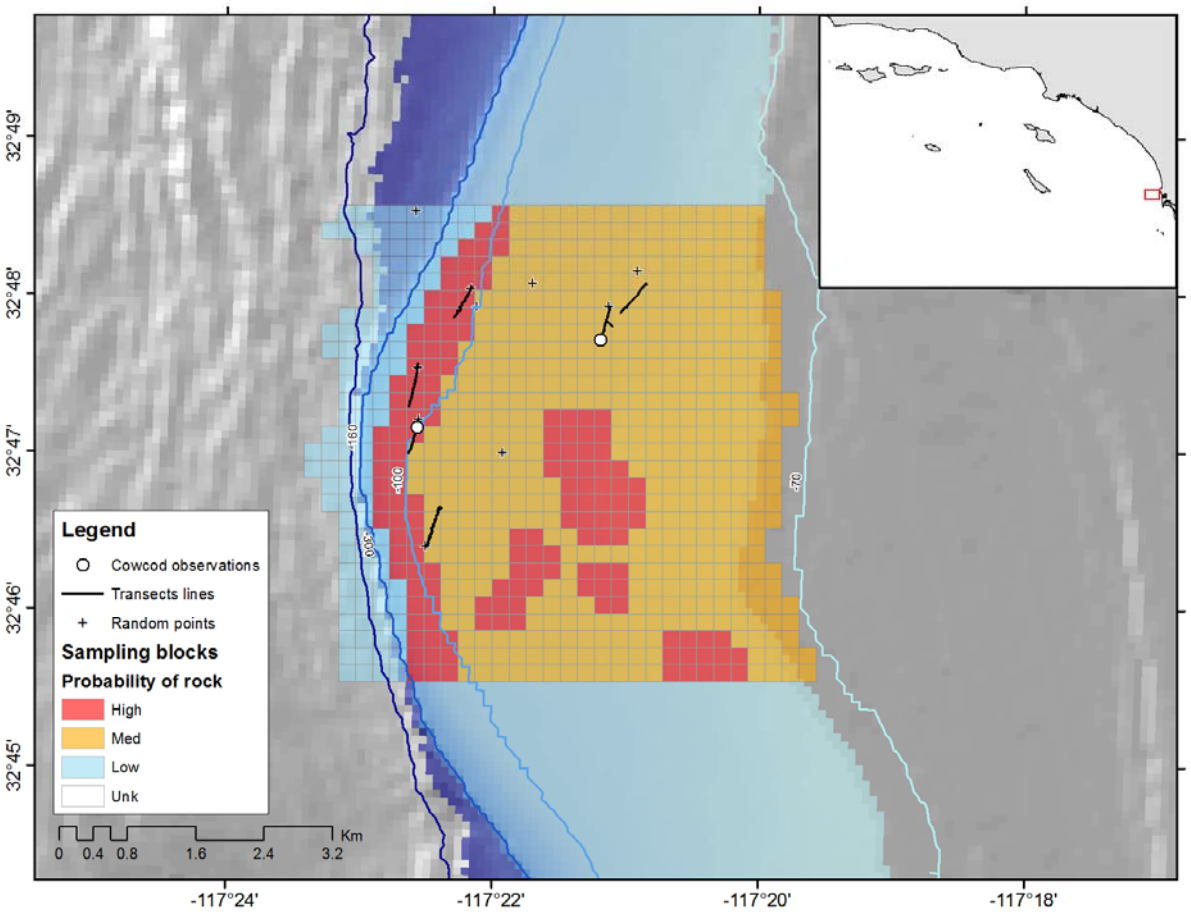

Figure 7. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from Mission Beach Reef.

Day 2: Osborn Bank
Start date: 10/11/2012 (Thurs)

14:07-01:08 (10/12/2012) Surveyed Osborn Bank (**Figure 8**)

Dive name: 12-285A (Point 173)
Start time: 14:07 **End time:** 14:36
Notes: Flat calm sea state. Landed on small boulders, transitioning into mud bottom. Large reef, methane seeps, pavement reef and sand.
Observations:
14:11 Adult *S. levis* (~50 cm) at sunrise
14:51 Video is flickering, recovering ROV

Dive name: 12-285B (Point 179)
Start time: 15:29 **End time:** 15:58
Notes: Excellent visibility. Flat calm sea state. A lot of sand with intermittent low-relief rock/boulder patches. Difficult to measure before it went into the rocks. First flickering of the video after bumping the ROV on a rock toward the end of the transect.
Observations:
15:36 Juvenile *S. levis*
15:49 Adult *S. levis*

Dive name: 12-285C (Point 170)
Start time: 17:00 **End time:** 17:28
Notes: Flat calm sea state. Sloped sand bottom. Nothing interesting. No pictures taken.
Observations:
No *S. levis*

Dive name: 12-285D (Point 171)
Start time: 18:12 **End time:** 18:49
Notes: Excellent visibility. Flat calm sea state. Cobble, boulders, with intermittent high relief out crops and sandy patches. Three adult *S. levis*.
Observations:
18:15 Adult *S. levis*
18:38 Adult *S. levis*
18:45 Adult *S. levis*

Dive name: 12-285E (Point 174)
Start time: 19:41 **End time:** 20:10
Notes: Excellent visibility. A multi-sectioned transect along the south-facing slope at mid-bank. A bit sandy initially, turning to sloping rock mixed with sand. There were several high relief areas and lots of fish. Three *S. levis* observed.
Observations:
19:49 Adult *S. levis*
19:50 Adult *S. levis*
19:53 Adult *S. levis*

Dive name: 12-285F (near Point 174)
Start time: 20:46 **End time:** 21:07
Notes: Slight texture on the surface, otherwise, excellent operating conditions. High relief reef with intermittent sand patches.
Observations: No *S. levis*

Dive name: 12-285G (Non-random site on the south side of the bank)
Start time: 21:50 **End time:** 22:27
Notes: Sand, pavement reef, large boulders, sand covered boulders and cobble, and steep slope
Observations
21:58 Adult *S. levis*

Dive name: 12-285H (Point 172)
Start time: 23:31 **End time:** 23:54
Notes: Sand and pebbles at start of the transect. Seas were flat, and water clarity was good. Really nothing observed but sand, crabs, and flatfish.
Observations:
No *S. levis*
Dive name: 12-285I (Point 176)
Start time: 00:35 **End time:** 01:08
Notes: Seas calm and visibility good. Depth ~150 m. Bottom has sparse cobble coverage with intermittent boulders.
Observations:
00:39 Juvenile *S. levis*
00:50 Adult *S. levis*; the bottom is becoming more complex
00:53 Juvenile *S. levis* in a sponge
01:00 Juvenile *S. levis* in a sponge
01:06 Boulders present and encrusted in a "sulfur yellow"-colored substance

End of survey at Osborn Bank. Transiting to the next site at San Nicolas Island.

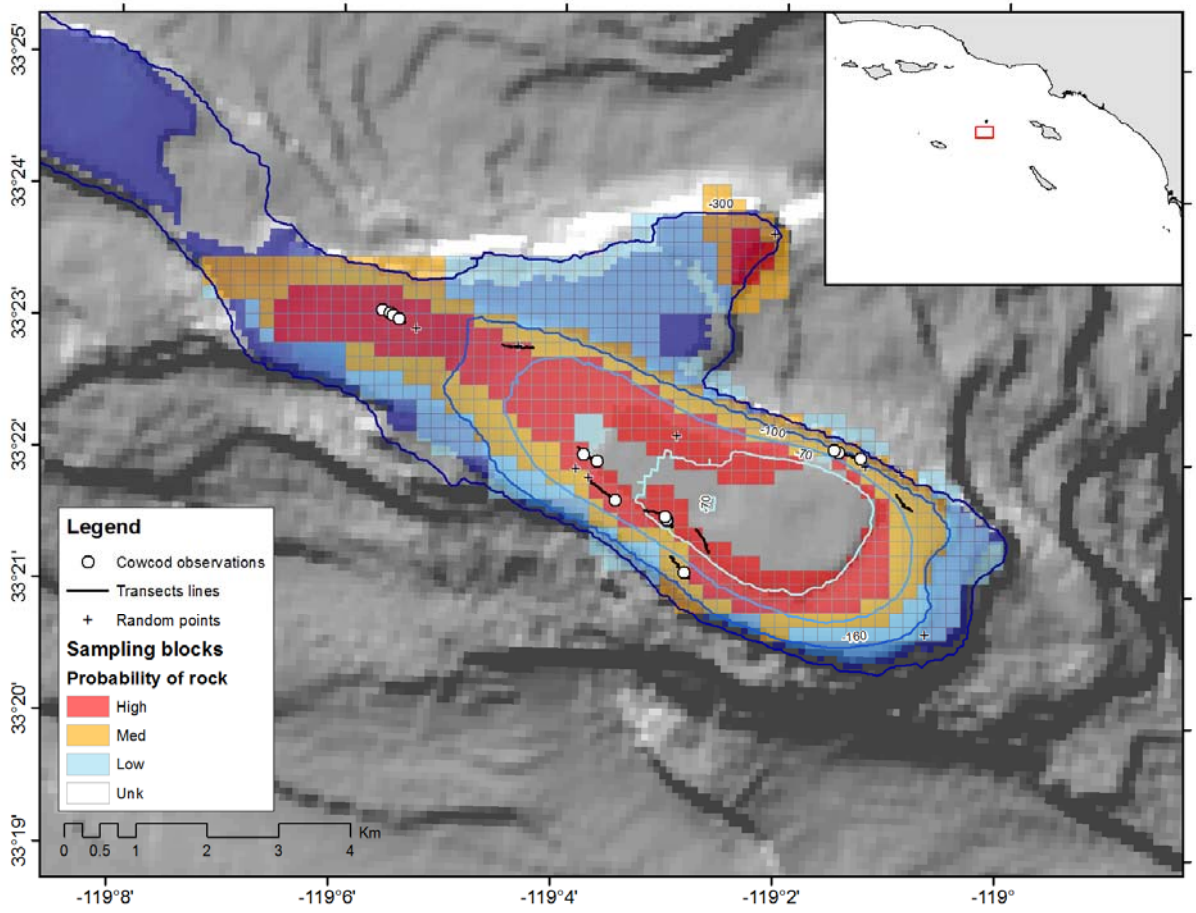

Figure 8. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from Osborn Bank.

Day 3: San Nicolas Island (East)
Start date: 10/12/2012 (Fri)

14:24-23:14 Surveyed E San Nicolas Island (**Figure 9**)

Dive name: 12-286A (Point 223)
Start time: 14:24 **End time:** 14:51
Notes: Sand, lots of wind 10 kt, surface current 1.5 kt, survey depth 130 m.
Observations: No *S. levis*

Dive name: 12-286B (Point 224)
Start time: 15:54 **End time:** 16:18
Notes: Swell less than 1 m, wind <10 kt, sand/small cobble with intermittent rocks, survey depth 95 m, poor visibility. No pictures downloaded. Large *S. caurinus* and *S. miniatus* rockfishes.
Observations: No *S. levis*

Dive name: 12-286C (Point 229)
Start time: 18:13 **End time:** 18:41
Notes: Favorable operating conditions. Good habitat. There are intermittent large rocks with lots of fish. There are some sand patches that have cobble/boulders.
Observations: No *S. levis*

Dive name: 12-286D (Point 221)
Start time: 19:29 **End time:** 19:55
Notes and Observations: Favorable operating conditions, sand with cobble, no Camview.
Observations:
19:33 Juvenile *S. levis*

Dive name: 12-286E (Point 225)
Start time: 21:21 **End time:** 21:51
Notes: Winds 10-12 kt and 0.5-1 m swell. Bottom depth varied from 200-240m with some steep rocky ledges and silt covered flats. Many spot prawns were observed along with a prawn trap. No big fish were seen in this area.
Observations: No *S. levis*

Dive name: 12-286F (Point 231)
Start time: 22:50 **End time:** 23:14
Notes: winds 10-12 kt and 0.5-1 m swell. A lot of sand is present at this site with a few small schools of halfbanded rockfish.
Observations: No *S. levis*

End of survey at E San Nicolas Island. Transiting to Santa Barbara Island.

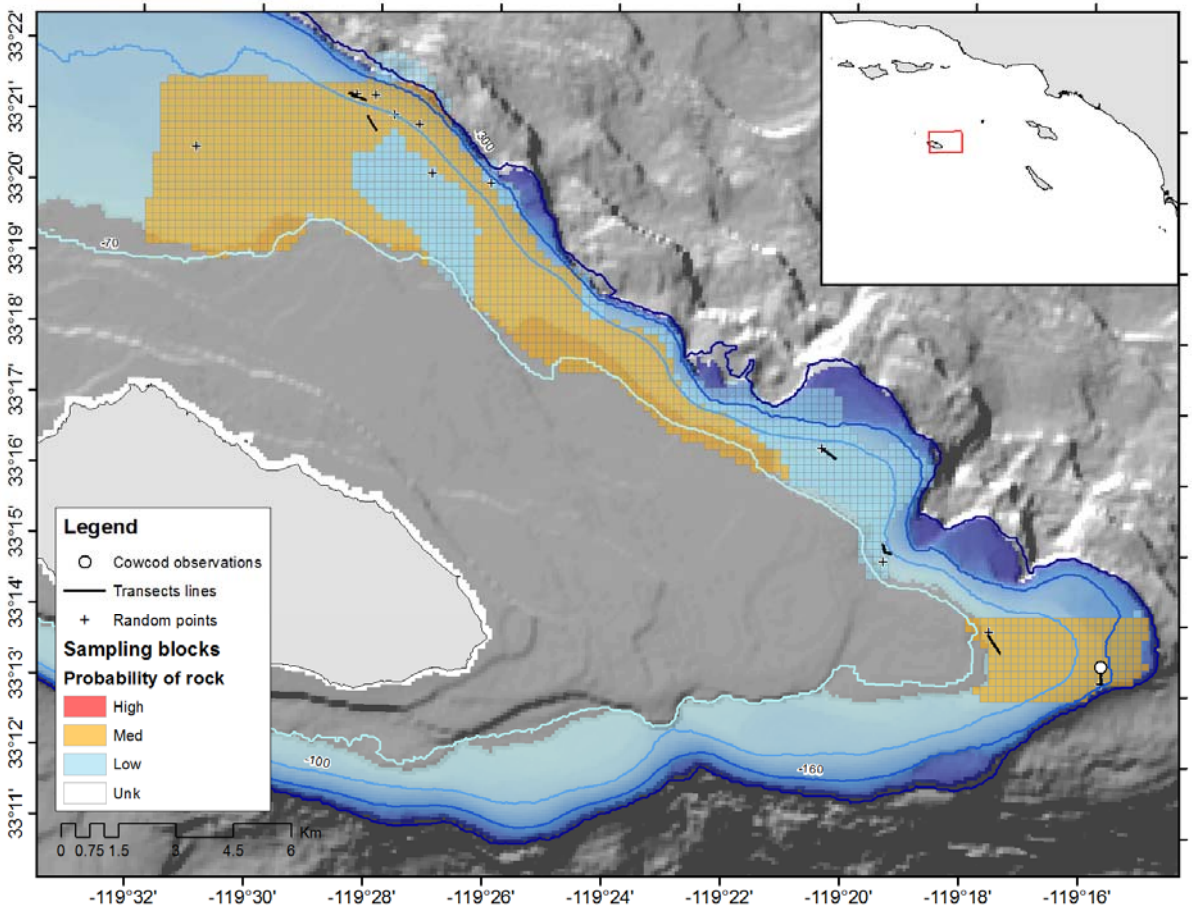

Figure 9. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from E San Nicolas Island.

Day 4: Santa Barbara Island
Date: 10/13/2012 (Sat)

14:18-00:34 (10/14/2012) Surveyed Santa Barbara Island (**Figure 10**)

Dive name: 12-287A (Point 260)
Start time: 14:18 **End time:** 14:38
Notes: calm seas, wind mild, sloping sand bottom, 180 m. No Camview files.
Observations: No *S. levis*

Dive name: 12-287B (Point 256)
Start time: 15:35 **End time:** 16:03
Notes: Seas calm, wind mild, started as mostly sand with cobble and crinoids. Switched to mostly cobble with some sand (~15:38), and then mostly cobble with some small boulders covered in crinoids (~15:40). Many small *Sebastomus* spp. are present with some *S. rubrivinctus* and *S. paucispinis.*
Observations:
17:06 Two juvenile *S. levis*, one right at the end of the transect

Dive name: 12-287C (Point 253)
Start time: 16:55 **End time:** 17:30
Notes: We removed yet another "kink" in the cable when we deployed before descent. The ship davit is having issues on deployment which keeps the arm from pivoting far enough over the rail. On Location is experiencing recording (or the inability to record) issues. The on location did not start recording for ~5 min after tapes. OnLocation (or the PC it runs on) actually has problems nearly every single transect. Depth 140 m. Bottom initially cobbles then turned mostly sand with pebble. Operating conditions are excellent at this site with many schools of *S. semicinctus*.
Observations:
17:05 Juvenile *S. levis* (~10 cm)

Dive name: 12-287D (Point 261)
Start time: 18:18 **End time:** 18:34
Notes and Observations: Sunny and warm, almost no wind, CTD cast on the way down, sand bottom, octopus and world record sand dab, beer can.
Observations: No *S. levis*

Dive name: 12-287E (Point 255)
Start time: 19:30 **End time:** 19:56
Notes: Sunny and warm, with very little wind. Visibility on the bottom was moderate. The seabed was mostly sandy and flat with flatfishes and crabs. Several turns observed in the rear-facing camera, and a few blinks from the video prior to losing controls, which could be related. Suggest disconnecting the tether from the ROV and walking-out the turns. Upon retrieval, no major turns in the tether were observed so we chose to leave it connected until next transect, at least. Lost the control system for about 2 min (19:37).
Observations: No *S. levis*

Dive name: 12-287F (Point 258)
Start time: 20:45 **End time**: 21:27
Notes: Operating conditions are ideal. Rocky habitat (~2 m relief) initially turning to cobble/boulder and back to high relief reef. *S. levis, S. hopkinsi, S. miniatus, S. semicinctus, S. rubrivinctus, S. wilsoni, S. elongatus, and S. chlorostictus* among many other species on reef. Bank is covered with fish. Debris (line) draped over reef.
Observations:
20:47 Juvenile *S. levis*
20:59 Longline
21:03 Adult *S. levis*; went to hide in reef
21:07 Juvenile *S. levis*
21:07 Adult *S. levis* on left side of screen went to hide in crevice
21:12 Adult *S. levis* in crevice of reef
21:16 Adult *S. levis*
21:17 Adult *S. levis* on top of sponge that dropped into a crevice; difficult to photograph
21:19 Adult *S. levis* in crevice
21:21 Juvenile *S. levis* off bottom

Dive name: 12-287G (E of Point 258)
Start time: 21:37 **End time**: 22:04
Notes and Observations: Operating conditions are ideal. Rocky habitat cobble/boulder and boulder sand, methane seep, *S. rubrivinctus* rockfish, some pavement reef, lots of *S. chlorostictus* and small rockfish. Lot of *S. hopkinsi, S. miniatus, S. rubrivinctus, S. ovalis*, and *O. elongatus*.
Observations:
21:43 Adult *S. levis* gravid right center (not logged initially, but added a log entry afterward)
21:54 Adult *S. levis* (~50 cm)
21:57 Juvenile *S. levis*

Dive name: 12-287H (Point 255)
Start time: 22:53 **End time:** 23:11
Notes: ~100 m bottom depth. Mostly sand and evenly spaced cobble with crinoids to start. Changed to all cobble with small boulders (22:53). Transect started below Point 255 in a yellow portion of Cutter's habitat map, which corresponded to rocky on other portions of the site. ROV HD video flickered a lot and vehicle was recovered early.
Observations: No *S. levis*

Dive name: 12-287I (Point 262)
Start time: 23:57 **End time:** 00:34
Notes and Observations: Depth 175 m. Sea conditions are mellow. Bottom is sand with intermittent boulders and cobble. Schools of *S. semicinctus*. HD video flickering is better but still present. Towards the end of the transect we encountered moderate complexity reef.
Observations: No *S. levis*

Completed surveying Santa Barbara Island. Moored at Santa Barbara Island overnight.

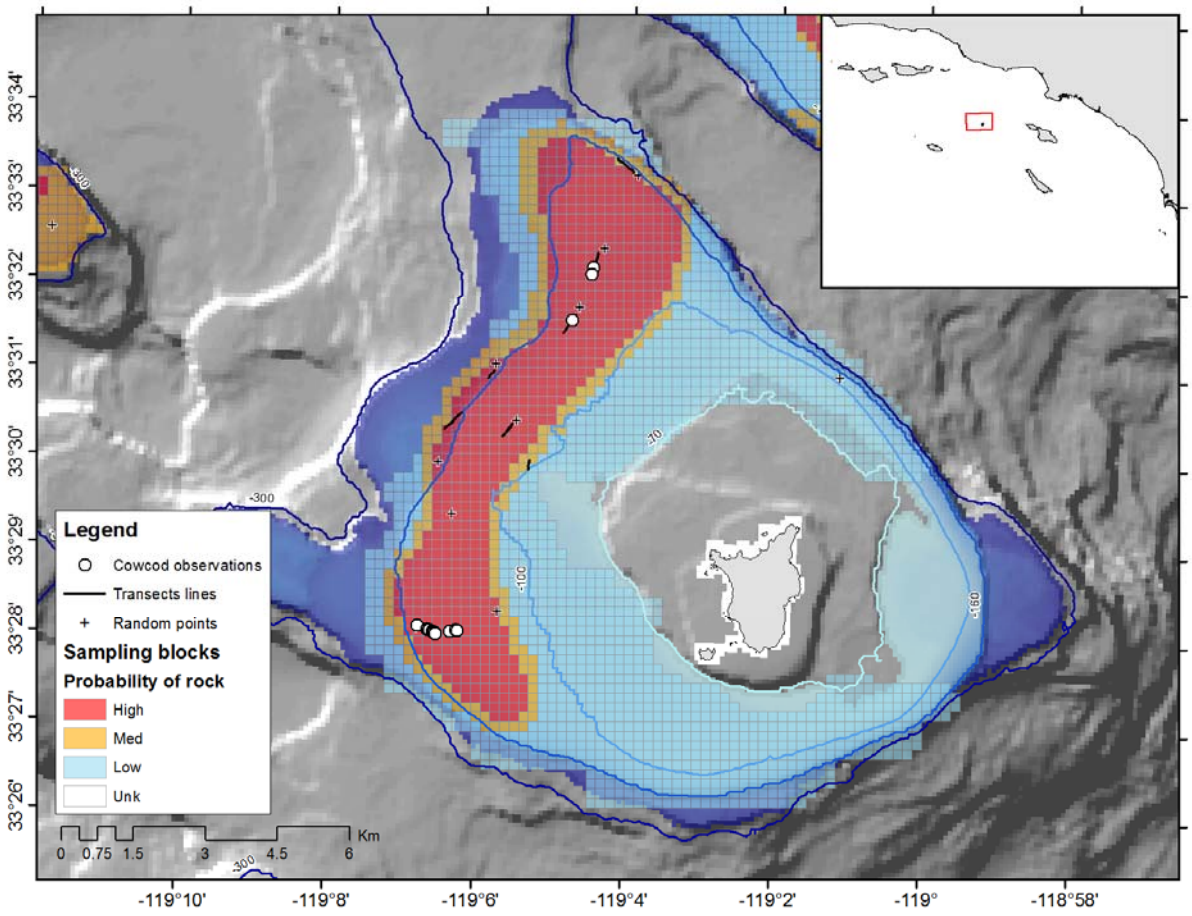

Figure 10. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from Santa Barbara Island.

Day 5: Hidden Reef
Date: 10/14/2012 (Sun)

14:10-00:29 (10/15/2012) Surveyed Hidden Reef (**Figure 11**)

Dive name: 12-288A (Point 133)
Start time: 14:11 **End time:** 14:54
Notes: Operating conditions are ideal. Large reef structure covered in brittle stars and crinoids, 130 m depth, *S. jordani*, *S. paucispinis*, *S. wilsoni*, *S. hopkinsi*, *S. ensifer*, *S. ovalis*, *S. rufus*.
Observations:
14:45 Adult *S. levis* (~50 cm)

Dive name: 12-288B (Point 130)
Start time: 15:13 **End time:** 15:48
Notes: Calm seas and sunny. Sand initially, changing to large boulders and low-relief reef with sand covered in crinoids and brittle stars.
Observations:
15:26 Juvenile *S. levis* (~40 cm)
15:33 Change to mostly sand
15:39 Back in rock and boulders
15:40 Two adult *S. levis*; one likely impossible to measure accurately
15:43 Adult *S. levis* (~60 cm)

*****A large gash was noted in the tether at ~110m above the strain relief (~150 m from the termination)***

16:20 WinFrog crashed while entering a new waypoint. A corrupted winfrogini.wfg file was the culprit but it took ~1.5 hours to find and correct the issue.

Dive name: 12-288C (Point 137)
Start time: 17:57 **End time:** 18:18
Notes: Depth 190 m. Sloped sandy bottom covered in Urchins. Nothing but sand on this transect.
Observations: No *S. levis*

Dive name: 12-288D (Point; W of Point 129)
Start time: 19:15 **End time:** 19:43
Notes: Saw *S. levis* upon reaching the bottom. It wasn't counted in transect. Depth 118 m, rocky reef, covered in crinoids and brittle stars, down to sand bottom covered in brittle stars, Christmas tree corals, back to rocky reef, covered in crinoids and brittle stars, *S. ruberrimus*. A lot of *S. hopkinsi*. Clump weight was sliding up the side of the reef. The weight was cleared from the reef. Some blinking was observed in the video, so the transect was cut short to inspect the gear. Vehicle recovered. All looked OK upon inspection. Four adult *S. levis* and 1-2 adult *S. ruberrimus* all in one area.
Observations:
19:34 Adult *S. levis*
19:35 Adult *S. levis*
19:35 Adult *S. levis*
19:36 Adult *S. levis*

Dive name: 12-288E (Point 132)
Start time: 20:24 **End time:** 21:04
Notes : Sand, large boulders and high-complexity reef covered in crinoids initially. A lot of polychaete tubes encrusting the reef (~20:30).
Observations:
20:33 Adult *S. levis*
21:01 Adult *S. levis*

Dive name: 12-288F (Non-random transect)
Start time: 22:12 **End time:** 22:49
Notes: Depth 176 m, rocky reef (lower relief than previous transect)
Observations:
22:25 Off rocks and onto sandy bottom with urchins
22:30 Started recording to hard drive
22:30:59 Off effort
22:32:30 On effort
22:37:35 Adult *S. levis*
22:47:30 Large steel cable

Dive name: 12-288G (Point 135)
Start time: 23:40 **End time:** 23:52
Notes: Control system went down on decent and had to be rebooted. Large *Lophelia* reef. Separated as a "Deep coral transect".
Observations: No *S. levis*

Dive name: 12-288H (Point 135)
Start time: 23:55 **End time:** 00:29
Notes and Observations: Large rocky reefs, not seeing any big fish but good habitat. down to sand, few *S. hopkinsi*, *S. paucispinis*, *S. wilsoni*, *S. ovalis*, many *Antipathes*, *Lophelia* in small patches, *S. constellatus*.
Observations: No *S. levis*

Completed surveying Hidden Reef. Moored at Santa Barbara Island overnight.

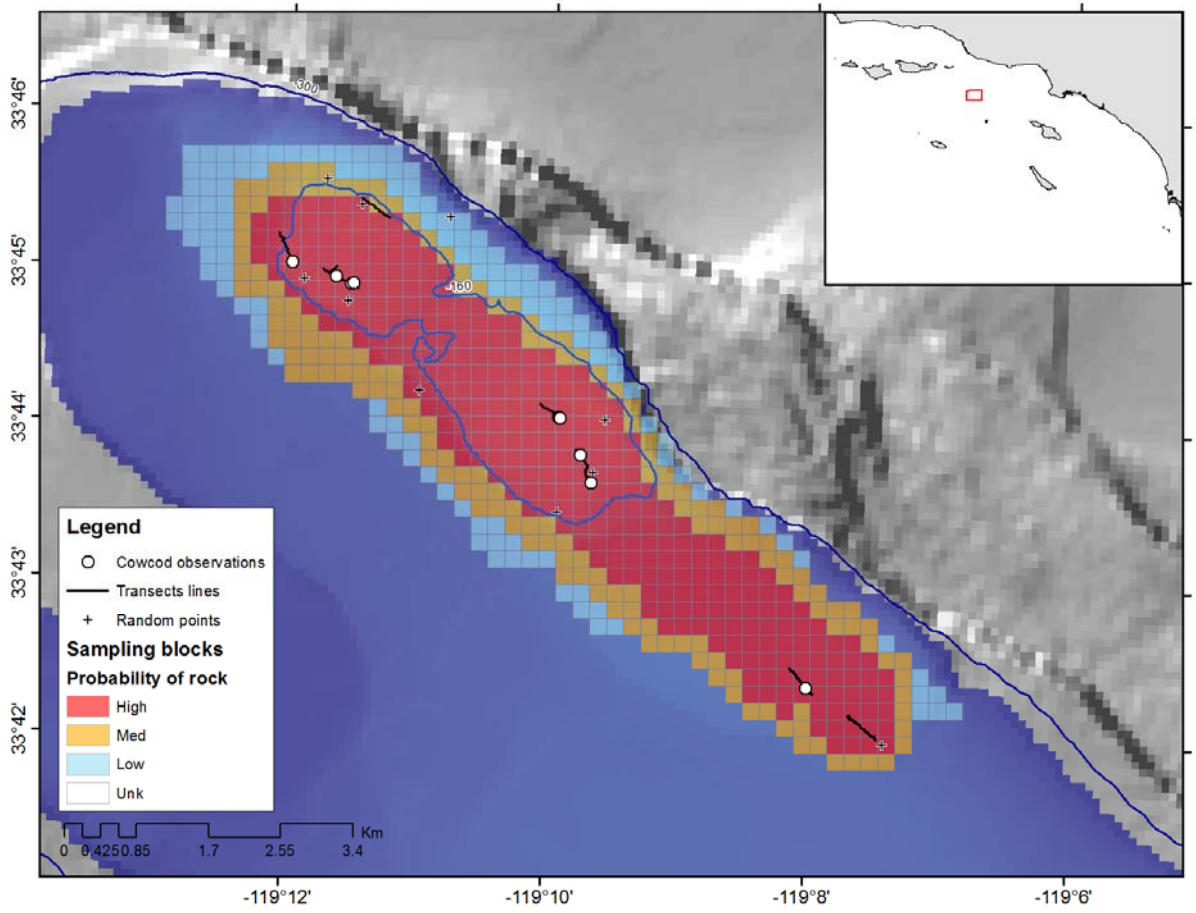

Figure 11. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from Hidden Reef.

Day 6: The Kidney (West)
10/15/2012 (Mon)

14:26-23:52 (10/16/2012) Surveyed the west portion of The Kidney (**Figure 12**)

Dive name: 12-289A (Point 148)
Start time: 14:27 **End time:** 15:02
Notes and Observations: Breezy and choppy with 1-1.5 m swell in the morning. Large cobble and small boulders.
Observations:
14:31 Juvenile *S. levis* (8-10 cm) in cobble; also an adult *S. goodei*
14:36 Adult *S. levis* (40-50 cm) in cobble, small boulder
14:48 Off effort
14:50 On effort
14:58 Adult *S. levis* (~40 cm) resting on the seabed

Dive name: 12-289B (Point 139)
Start time: 16:12 **End time:** 16:50
Notes: Depth 145, small and large boulders
Observations:
16:12 Two adult *S. levis* in boulders
16:17 Adult *S. levis* (45 cm) in large boulders
16:25 Boulders smaller, large cobble/sand
16:29 Two adult *S. levis* (1 gravid) in large boulders
16:41 *S. levis* (40 cm) in medium boulders
16:44 Bronzespotted rockfish; great photo

Dive name: 12-289C (Point 142)
Start time: 17:42 **End time:** 18:02
Notes: Depth 142, small boulders and cobble with mud in between, bottle, few small rockfish, *S. rubrivinctus*, *S. chlorostictus*, lots of *S. ensifer*, blinking video due to kink around clump weight.
Observations: No *S. levis*

Dive name: 12-289D (Point 143)
Start time: 19:00 **End time:** 19:38
Notes: Wind and swell have subsided a little with clear skies. Cobble substrate covered in brittle stars and crinoids. A lot of *S. ensifer*, *S. wilsoni*, and some *S. hopkinsi*.
Observations:
19:03 Adult *S. levis* in rocky reef
19:11 Adult *S. ruberrimus* rockfish and a few *Antipathes* colonies
19:14 Adult *S. levis* on the seabed
19:19 Adult *S. levis*
19:21 Adult *S. levis*
19:34 Adult *S. levis* (~50 cm)
19:35 Adult *S. ruberrimus* (quite large)
19:35 Adult *S. levis*
19:36 Adult *S. levis*
19:37 Adult *S. levis*

Dive name: 12-289E (Point 141)
Start time: 20:42 **End time:** 21:16
Notes: Swell ~1-1.5 m, winds ~5kt. Seabed is cobble/boulder initially.
Observations:
21:03 Adult *S. levis*
21:10 Juvenile *S. levis* in a sponge
21:12 Adult *S. levis*
21:14 Adult *S. levis*

Dive name: 12-289F (Deep transect S of Point 141)
Start time: 22:02 **End time:** 22:29
Notes: Boulders and sand on slope, depth 175 m, sand patch where Kevin spun out a turn that probably caused flashing of the video, flashing stopped, started a few more times while finishing the transect. Tether was very tightly twisted and wrapped above the clump weight, and a few turns below the clump weight. Recommend removing turns from the tether at the end of the day.
Observations: No *S. levis*

Dive name: 12-289G (non-random site)
Start time: 23:25 **End time:** 23:52
Notes: Breezy and a little choppy. Cobble and sand with brittle stars and a lot of sponges. Very few fish of any kind, but seemingly good habitat. Some *Sebastomus* spp., probably *S. ensifer* rockfish. The umbilical was removed from the vehicle on deck and we attempted to remove any turns from the last 60 m of the cable. It seemed to have ~3 turns in it, but difficult to know for sure.
Observations: No *S. levis*

Moored at Santa Barbara Island overnight.

Day 7: The Kidney (East)
10/16/2012 (Tue)

14:46-20:21 (10/17/2012) Surveyed the east portion of The Kidney (**Figure 12**)

Dive name: 12-290A (Near Point 144)
Start time: 14:16 **End time:** 14:46
Notes: Calm wind and 0.5-1 m swell with little or no chop.
Observations: The sea conditions are favorable for ROV operations (calm wind, moderate long period swell). The bottom is mostly cobble and boulders with a few sandy patches. The depth is 135 m. The ROV dropped down right on a *S. levis*. There are many other large and small Sebastes sp. in the area. Camview was not recorded for this transect.
14:16 Adult *S. levis*
14:27 Adult *S. levis*
14:28 Adult *S. levis*
14:36 Adult *S. levis*
14:38 Adult *S. levis*
14:39 Adult *S. levis*
14:40 Adult *S. levis*
14:41 Adult *S. levis*
14:42 Adult *S. levis*; no photo or lasers
14:43 Adult *S. levis*

Dive name: 12-290B (Point 144)
Start time: 14:56 **End time:** 15:16
Notes: Calm wind and 0.5-1 m swell with little or no chop. There were 2 *S. levis* observed while transiting underwater to this transect site (off effort) and were not included in the counts. The bottom was all sand for this transect.
Observations: No *S. levis*

Dive name: 12-290C (Non-random transect)
Start time: 16:23 **End time:** 17:04
Notes: Smooth seas (2-3' long-period swell) with no chop and a nice breeze. Mostly large cobble and small boulders with crinoids and brittle stars. Some current on the bottom. A LOT of large predatory fishes (*S. levis*, *S. paucispinis*, and *O. elongatus*) upon reaching the bottom. Current on the bottom is making it difficult to maintain a heading in line with the transect direction. Seems that tracking continues to move when the ROV is stationary on the bottom (noted during on/off effort times).
Observations:
16:23 Adult *S. levis*
16:26 Adult *S. levis*; stayed ahead of ROV and unable to photograph; log entered
16:39 Off effort; waiting for the ship to catch up
16:41 On effort
16:43 Adult *S. levis*
16:47 Off effort
16:48 On effort
16:51 Possible *S. brevispinis*
16:54 Another possible *S. brevispinis*
16:55 Off effort
16:56 On effort
16:59 A lot of dwarf rockfishes
17:03 Large *Antipathes* colony amid a cobble field

Dive name: 12-290D (Non-random transect)
Start time: 18:02 **End time:** 18:27
Notes: Smooth seas (0.5-1 m long-period swell) with no chop and a nice breeze. Depth 185 m. Large cobble and small boulders (evenly spaced out with sandy patches in between). Mostly sand by 18:14.
Observations: No *S. levis*
18:15 Habitat changes to hard pavement, low complexity with small cobble and sand/urchins
18:20 Bottom turned from mostly sand to mostly cobble with sponges

Dive name: 12-290E (Non-random transect)
Start time: 19:58 **End time:** 20:21
Notes: Sandy bottom with cobble and small boulders and pebbles, small rockfishes, longnose skate.
Observations: No *S. levis*

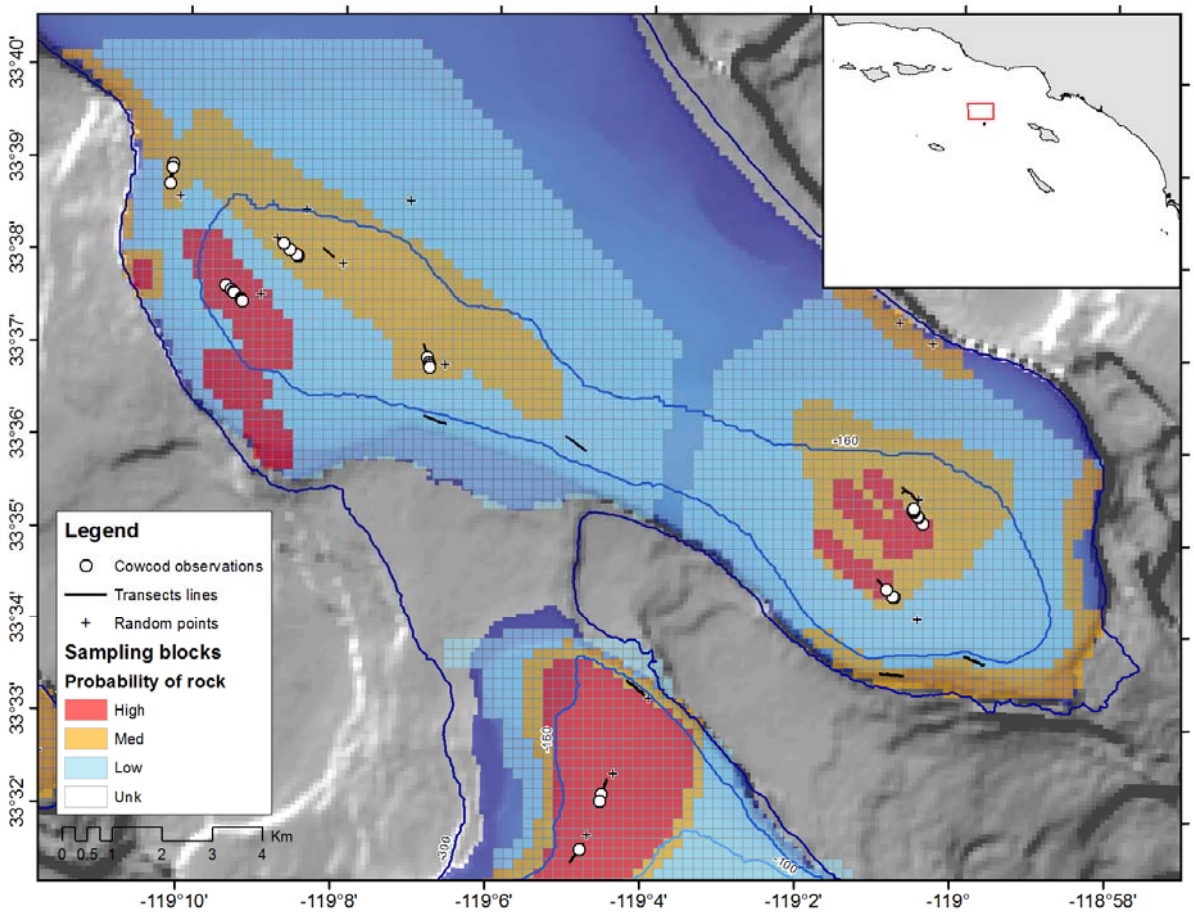

Figure 12. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from The Kidney. The northern portion of Santa Barbara Island can be seen in the lower portion of the map.

Day 7: 117 Seamount
10/16/2012 (Tue)

22:39-23:57 (10/17/2012) Surveyed the 117 Seamount, east of Santa Barbara Island (**Figure 13**)

Dive name: 12-290F (NW of Point 11 in high probability habitat)
Start time: 22:40 **End time:** 23:18
Notes: Seas still calm with 0.5-1 m long-period swells. Foggy and calm. Bottom depth ~215 m. Very large boulders with sand/mud in between. Less visibility than other sites (maybe 3-4 m). Some interesting sea stars. *S. rufus*, *S. jordani*, and *S. goodei* rockfishes. Not many fish in general. Transited underwater to the beginning of the next transect.
Observations: No *S. levis*
22:54 Sixgill shark!!

Dive name: 12-290G (Point 11)
Start time: 23:26 **End time:** 23:57
Notes: Seas still calm with 0.5-1 m long-period swells and wind texture on the surface. The depth is 215 m. The bottom is covered with large boulders and very few fish (*S. rufus*, *S. paucispinis*). The sea bed transitions to mostly cobble with occasional boulders about mid transect. Towards the end of the transect we began seeing more large boulders.
Observations:
23:27 Adult *S. levis*

Completed surveying the 117 Seamount. Not a lot of time to survey, so probably won't include in the final analysis. Moored behind San Nicolas Island overnight.

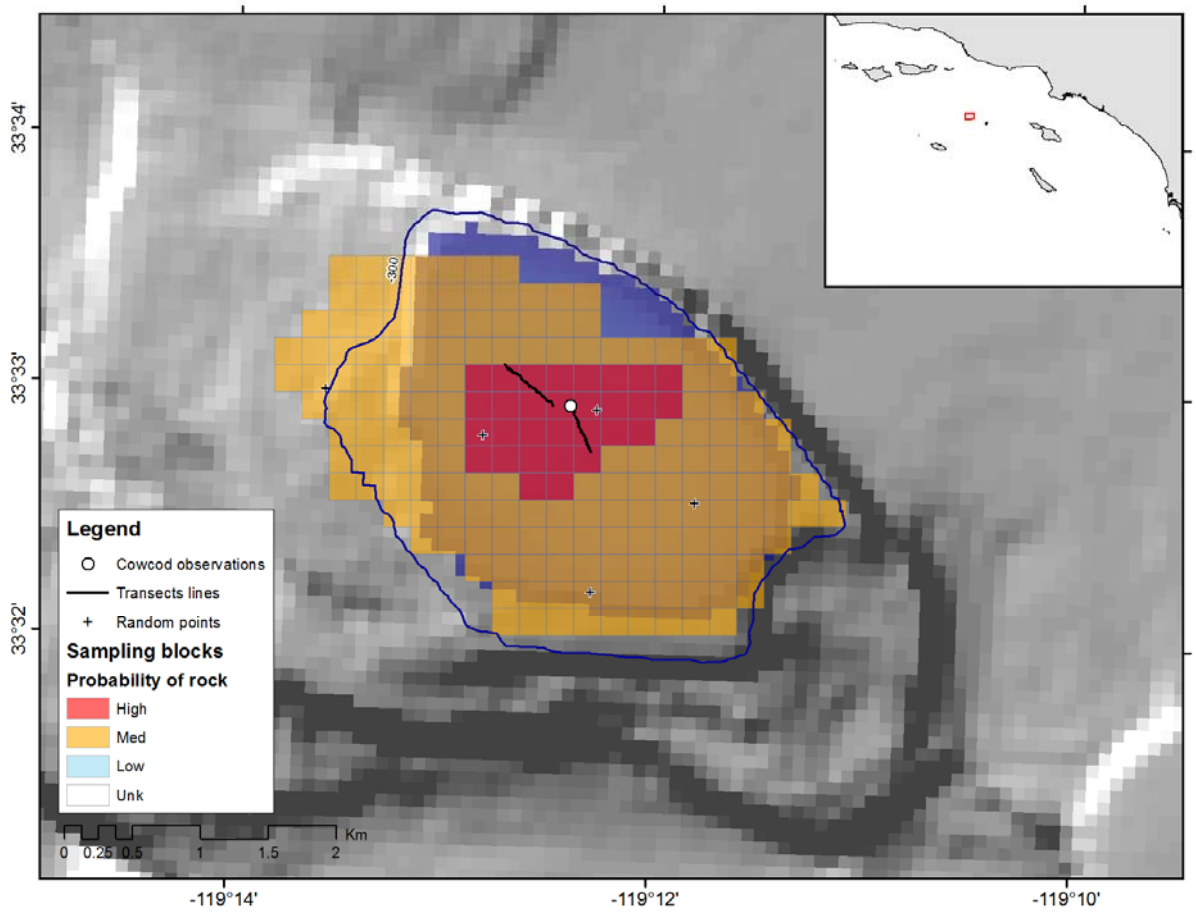

Figure 13. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from the 117 Seamount, west of Santa Barbara Island.

Day 8: Potato Bank
10/17/2012 (Wed)

14:34-00:49 (10/18/2012) Surveyed the Potato Bank (**Figure 14**)

Dive name: 12-291A (Point 183)
Start time: 14:34 **End time:** 15:13
Notes: Swell 1-2 m, Wind dying down, Boulders with cobble, *S. ensifer*, *S. chlorostictus*, basket stars, piled up pavement reef in spots. No video problems all transect. Transited underwater to the beginning of the next transect.
Observations:
15:05 Juvenile *S. levis*

Dive name: 12-291B (Point 184)
Start time: 15:27 **End time:** 16:01
Notes: Swell has subsided a little (probably 1-2 m) and wind is 5-10 kt. Bottom is cobble and scattered small boulders with sand/mud in between. Low abundance of rockfishes. Occasional school of *S. hopkinsi* and some *S. constellatus* and *S. chlorostictus*. Not many big fish in this area, and only sparse small fish.
Observations: No *S. levis*
15:32 Six-gill shark!!
15:40 Entering a large sand patch

Dive name: 12-291C (Point 180)
Start time: 16:51 **End time:** 17:22
Notes: Swell has subsided a little (probably 1-2 m) and wind is 5-10 kt. The bottom is cobble with intermittent boulders and sand patches. No big fish present, and sparse small fish (*S. ensifer, S. semicinctus*). Lots of current.
Observations:
16:52 Juvenile *S. levis*

Dive name: 12-291D (Point 181)
Start time: 17:34 **End time:** 18:04
Notes: High current, bigger boulders higher complexity than last transect, sand patches, *S. miniatus*, large boulders and scoured out mud, small rockfish, *S. ensifer*, *S. semicinctus*, *S. hopkinsi*
Observations:
17:54 Adult *S. levis*
17:59 Juvenile *S. levis* (~20 cm)
18:03 Adult *S. levis* (~55 cm) gravid female; no photo

Dive name: 12-291E (Point 188)
Start time: 18:54
End time: 19:22
Notes: Wind 3-5 kt and calm seas. Some large swells rolling through, but long period in between. High-relief, high complexity reef (uplifted bedrock?) and boulders. Moderate current on the bottom. Large schools of *S. hopkinsi* rockfish, sponges, and various corals. Several *S. ruberrimus*.
Observations:
19:01 Juvenile *S. ruberrimus*
19:02:30 Juvenile *S. ruberrimus*

19:03:45 Adult *S. ruberrimus*
19:18:30 Adult *S. levis* under a rock; good lasers for measuring

Dive name: 12-291F (Point 187)
Start time: 19:34 **End time:** 19:59
Notes: Wind 3-5 kt and calm seas. Some large swells rolling through, but long period in between. The bottom is complex with hard sloping slabs of rock with boulders in between. The control system dropped connection ~ half way through the transect. Not many fish for most of the transect. There were some large *S. paucispinis* and other species at the end.
Observations: No *S. levis*
19:47 Control system dropped connection

Dive name: 12-291G (Point 185)
Start time: 20:42 **End time:** 21:03
Notes: Wind ~5 kt and calm seas. Some large swells rolling through, but long period in between. Large sand patch followed by boulder field, large schools of *S. hopkinsi*, pavement reef with boulders on top, cruising along the reef sand interface, then on to pavement reef with boulder, large school of *S. hopkinsi*, large sand patch.
Observations: No *S. levis*

Dive name: 12-291H (Point 182)
Start time: 21:47 **End time:** 20:12
Notes: Wind 3-5 kt and calm seas. Some large swells rolling through with a long period in between. Mostly cobble with boulders covered in crinoids. Large schools of *S. hopkinsi* and some *S. paucispinis*; otherwise, not many fishes.
Observations: No *S. levis*
21:55 Sand field with large boulders spaced widely apart

Dive name: 12-291I (Point 189)
Start time: 22:59 **End time:** 23:23
Notes: Wind 3-5 kt and calm seas. Depth 90. Boulders with large schools of *S. hopkinsi*. Very nice habitat of highly complex boulder field. Once again, the small fish are abundant and there are not any larger fishes. The on location digital recording suite did not work for this transect.
Observations: No *S. levis*
23:14 We are beginning to see a few medium sized *S. paucispinis* and *S. miniatus*.
23:21 Moderate-sized *S. ruberrimus*.

Dive name: 12-292J (East of Point 189)
Start time: 00:31 **End time:** 00:50
Notes: Mud with boulders, 260 m, *Lophelia* rubble, octopus, and possible *S. eos*. Difficult to drive along the slope, and tracking was poor. Ended the transect early due to poor tracking and video blinking.
Observations: No *S. levis*

Completed surveying Potato Bank. Moored behind San Nicolas Island overnight.

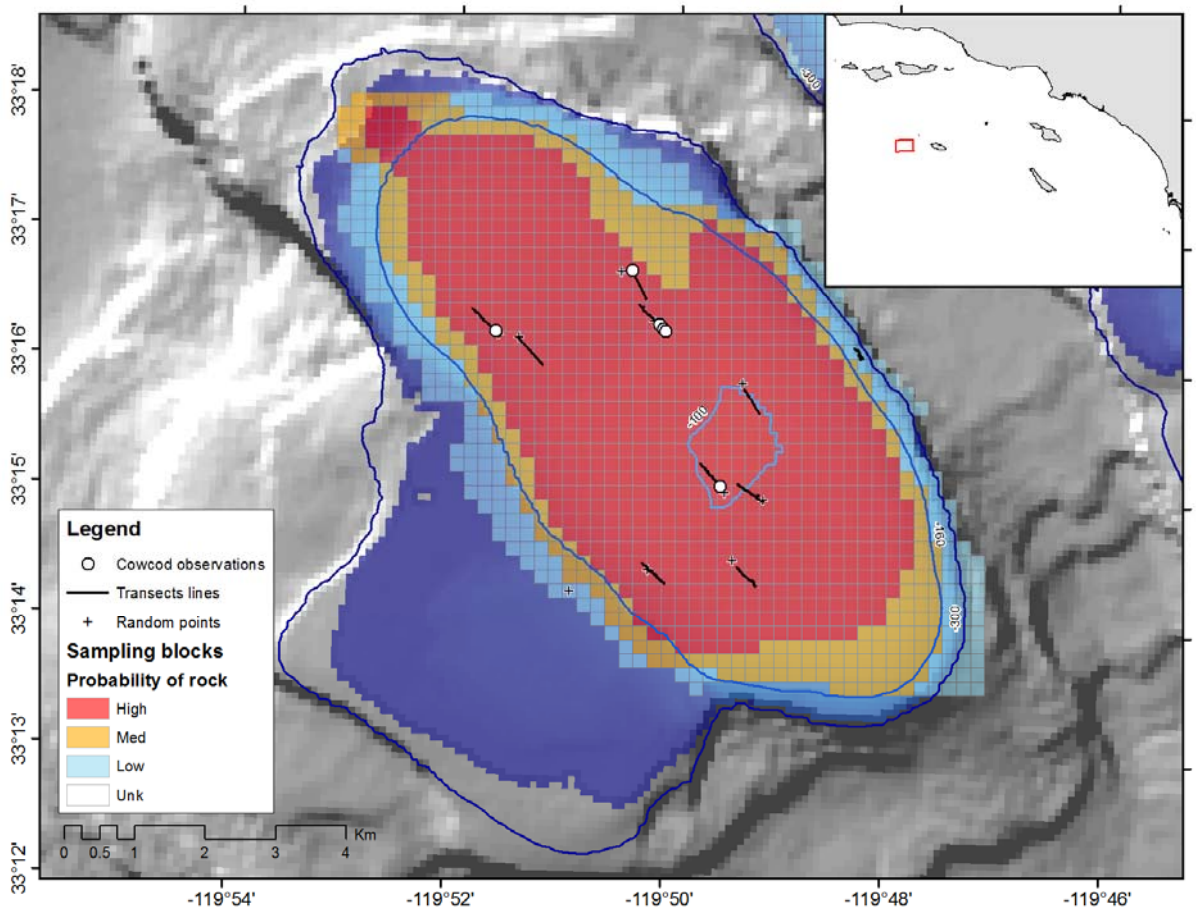

Figure 14. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from Potato Bank, west of San Nicolas Island.

Day 9: San Nicolas Island (West)
10/18/2012 (Thu)

14:40-15:15 Surveyed San Nicolas Island (West).

Dive name: 12-292A (Point 244)
Start time: 14:40 **End time:** 15:15
Notes: Breezy, blowing 5-15 kt. Swell 0.5-1 m with surface chop. Little or no current on the bottom. Large boulders piled high, and covered in crinoids and brittle stars. Small schools of *S. hopkinsi*, *S. paucispinis*, *S. miniatus*. Lasers turned-on late. Ended transect short; difficult to navigate against the prevailing current.
Observations: No *S. levis*
14:45:00 *S. ruberrimus* (large, red-phase juvenile)
14:48:30 *S. ruberrimus* rockfish
14:51:30 Seabed switching to mostly sand with cobble and small boulders
14:52:30 Seabed changed to low complexity, high relief reef with some boulders on top
14:56 Lasers just turned on
15:05 Off effort; end of the tether
15:09 On effort

Dive name: 12-292B (Point 242)
Start time: Dive aborted before start; see notes below.
Notes: Wind, swell, and chop has increased since the first transect. Difficult to keep-up with the clump weight during descent. Video dropped completely just before starting the transect. Control system dropped momentarily and returned. Surfaced with controls, and video returned on the surface when the tight bend in the tether was relaxed.

*****Departed San Nicolas Island (West) for San Pedro. Wind and current was not conducive to conducting surveys, and video was dropping badly. Some tight turns were observed in the tether between the clump weight and the ROV upon surfacing from transect 12-292B (aborted before start). Will try to fuel at San Pedro this evening and survey Lasuen Knoll on the morning of 10/19/2012 (Fri).***

Day 10: Lasuen Knoll
10/19/2012 (Thu)

14:28-19:55 Surveyed Lasuen Knoll (**Figure 15**)

Dive name: 12-293A (Point 150)
Start time: 14:28 **End time:** 14:58
Notes: The swell is ~0.5 m and the surface has slight wind texture. The bottom is covered with cobble and boulders. Squarespot rockfish are the predominate species. The video flickered one time. No Camview recorded.
Observations:
14:35 Longline
14:45 Adult *S. levis*; gravid female
14:47 Bottom turned to sand

Dive name: 12-293B (point 153)
Start time: 15:09 **End time:** 15:39
Notes: Boulder field to start transect., few bottles on the bottom, boulders with cobble, numerous *S. ensifer*, pull tab can, boulders with sand, PVC pipe
Observations:
15:10 Adult *S. levis*; disappeared quickly and no picture was taken
15:38 Stargazer

Dive name: 12-293C (point 152)
Start time: 16:57 **End time:** 17:22
Notes: Seas calm with some light chop; wind 3-5 kt. Mostly sand on the seabed. A lot of sand dabs and some sea whips and sea pens.
Observations: No *S. levis*
17:05 Possible small, unhealthy-looking *Lophelia* colony
17:07 Change to sand with small boulders
17:09 Another slightly larger *Lophelia* colony on a boulder
17:15:40 Longline across the sand on the seabed

Dive name: 12-293D (point 155)
Start time: 17:33 **End time:** 17:53
Notes: Seas calm with some light chop; wind 3-5 kt. Boulders throughout with abundant (mostly small) fish. Transited underwater to start of next transit.
Observations:
17:35 Boulders spaced out, more sand and less fish
17:38 Back to piled boulders with little sand and lots of small fish
17:39 Adult *S. levis* (~40cm)
17:39 Video flickering
17:44 Off effort; removing turns on the tether; flickering stopped
17:45 On effort
17:46 Boulders small but abundant; many small fish still (mostly *S. ensifer* and *S. hopkinsi*)
12:52 A few yellowtails in the boulders

Dive name: 12-293E (Point 151)
Start time: 18:01 **End time:** 18:34
Notes: Water calm, little chop. Sand bottom with a few intermittent boulders.
Observations:
18:05 Small *Lophelia* colony. No boulders and just sand for the next 10 min.
18:17 Habitat change: boulders; Lots of big fish around for the next ~10 min
18:19 Adult *S. levis* (45-50 cm)
18:21 Adult *S. levis* (50 cm)
18:22 Adult *S. levis* (gravid female)
18:23 Two adult *S. levis*
18:24 Four adult *S. levis*
18:25 Adult *S. levis*
18:27 Adult *S. levis* (43 cm)
18:30 Piles of boulders with smaller fish

Dive name: 12-293F (Point 154)
Start time: 19:23 **End time:** 19:55
Notes: Seas 0.5-1 m, wind 10-15 kt. Sand bottom.
Observations:
19:37 Two adult *S. levis*

Longline/polypropylene line and float wrapped just above the strain relief at the end of the transect. Removed at the surface and left behind. All seems OK with the ROV/tether so far. No WinFrog event was logged for the line to be avoided later.

Dive name: NO DIVE LOGGED (Near Point 157; but shallower)
Start time: 21:55
End time: N/A
Notes: 0.5-1 m swell, wind 15 kt and increasing.
Observations: The bottom is initially sand with flatfishes and urchins.
21:57 The bottom has turned to thick cobble and boulder

Dive aborted early due to deteriorating weather conditions and drift headed up slope making it risky for hanging the clump weight. No further transects were conducted at this site. Transited to Santa Catalina Island for the night. Anchored SW of Santa Catalina Island.

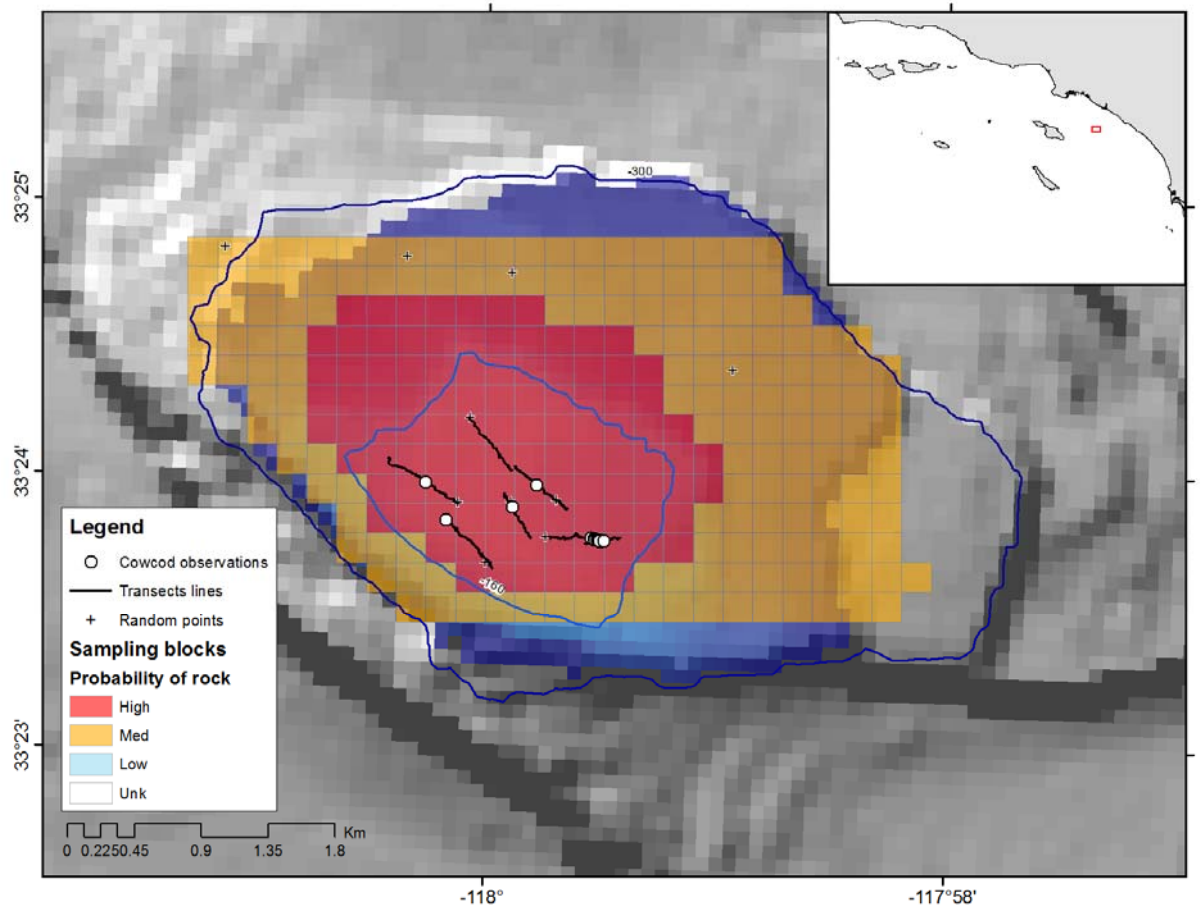

Figure 15. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from Lasuen Knoll, southeast of Long Beach, CA.

Day 11: Santa Catalina Island (Northwest)
10/20/2012 (Sat)

14:40-22:50 Surveyed Santa Catalina Island (Northwest) (**Figure 16**)

Dense fog and misty conditions with little to no wind. Seas were calm with sight surface chop. Attempted a transect at Farnsworth Bank first thing in the morning, but video was flickering a lot and the seabed was mostly sand. Decided to recover the ROV to examine the tether. All looks OK with the tether, but the strain relief was moved down the tether ~1m. Decided to transit to Santa Catalina Island (Northwest) in search of hard substrate.

Dive name: 12-294A (point 267)
Start time: 16:41 **End time:** 17:18
Notes: Landed on sandy bottom, bottom covered in white urchins and has some intermittent cobble covered in soft corals and crinoids, mild current, *S. semicinctus*, *S. paucispinis*, *Lophelia* colonies, with huge pinnacles, 45 m tall, lots of soft coral, line on sand bottom, large sedimentary pinnacles. The HD video has occasional flickers.
Observations: No *S. levis*
16:44 Polypropylene line on the bottom
17:00 Wolf eel
17:16 Fishing line

Dive name: 12-294B (Point 264)
Start time: 18:01 **End time:** 18:33
Notes: Seas are still calm with little or no wind. Overcast skies. Mostly sandy bottom. There are a lot of flatfishes, urchins, and sea whips.
Observations: No *S. levis*

*****Changed the angle of the fixed lights to a shallower angle to better illuminate ahead of the ROV when driving closer to the seabed with the camera at a flatter pitch.***

Dive name: 12-294C (Point 265)
Start time: 19:26 **End time:** 19:50
Notes: The swell is ~0.5 m with mixed direction. Winds are ~5 kt. Sandy bottom. There are a few small flatfish and sea whips. This place is desolate. There are not even any urchins around here. The ROV is preforming extremely well on an extremely uneventful transect.
Observations: No *S. levis*

Dive name: 12-294D
Start time: 20:40 **End time:** 21:06
Notes: Wind and seas are calm, sky is still overcast. Sandy bottom with many sea stars and urchins.
Observations: No *S. levis*
20:43 Large, steep boulders (small *Lophelia* patch)
20:45 Back to sand
20:48 Large boulders, not many fish around
20:51 Sand and urchins
20:53 Off effort
20:54 On effort

Dive name: 12-294E
Start time: 22:09 **End time:** 22:50
Notes: High-relief, high-complexity reef and boulders with sand in between. A lot of fish; *S. hopkinsi*, *S. ovalis*, *S. rubrivinctus*, *S. paucispinis*. Many large purple (~1 m across) and orange gorgonians. Visibility is relatively poor, maybe 3-4m. Rocks seemed to be covered in more silt than 12-294A.
Observations:

22:15 Lost the control system for about 2 min; restarted LabView and all is OK
22:20 Large schools of *S. hopkinsi*
22:24 Juvenile *S. levis* (~10-15 cm) among purple Gorgonians.
22:29 Juvenile *S. caurinus* (~10-15 cm)
22:35 Entering sand with scattered boulders
22:37 entering high-relief rock again

Completed surveying Santa Catalina Island (Northwest). We anchored near Santa Catalina Island until ~midnight. Transited to 43 Fathom Bank, scheduled to arrive around sunrise.

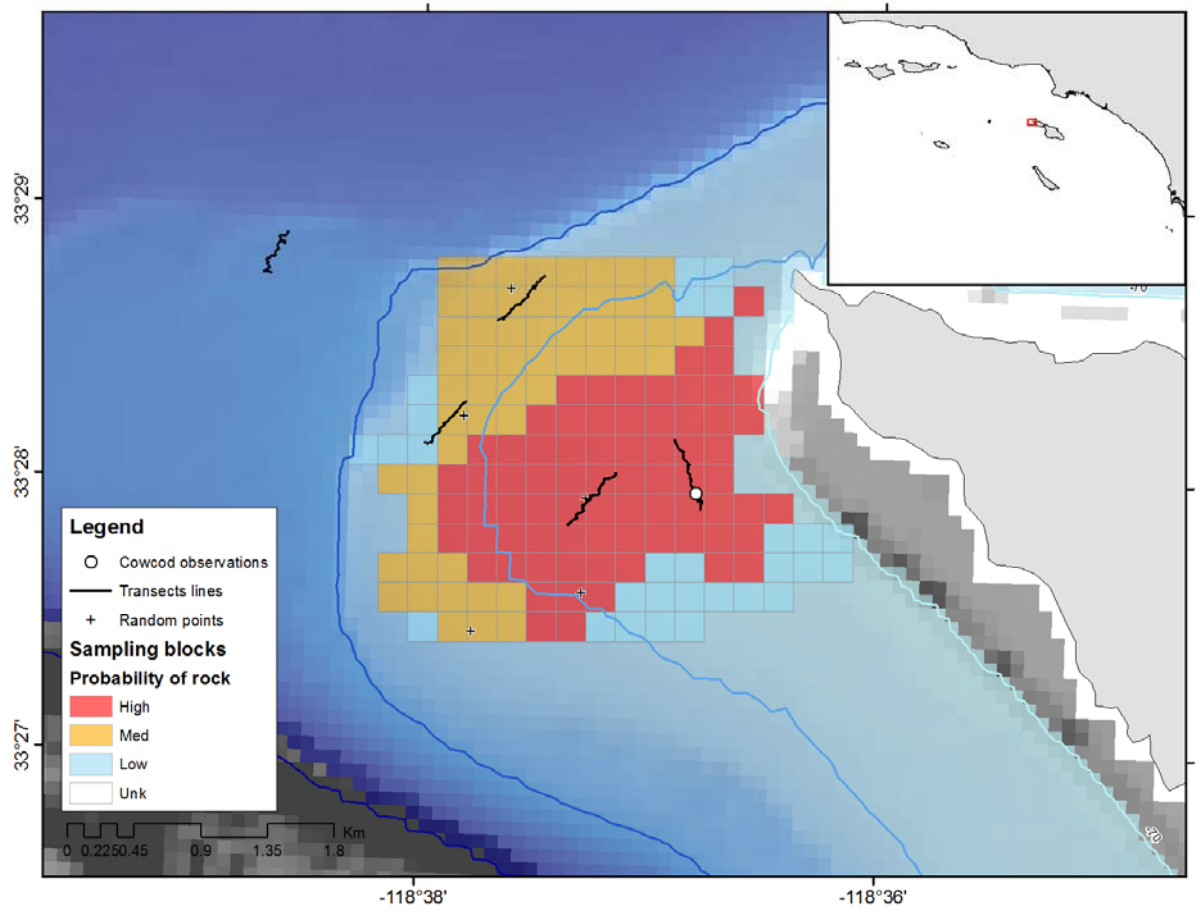

Figure 16. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from Santa Catalina Island (Northwest).

Day 12: 43 Fathom Bank
10/21/2012 (Sun)

14:20-17:20 Surveyed a portion of the 43 Fathom Bank (**Figure 17**)

Dive name: 12-295A (Point 30)
Start time: 14:21 **End time:** 14:44
Notes: Breezy (~7 kt) with moderate swell (0.5-1 m) with some surface chop. There are low clouds and weather looming to the W. The bottom is moderate complexity boulders interspersed with sand patches. There are some juvenile rockfish, small *S. hopkinsi*, and *S. paucispinis*.
Observations: No *S. levis*
14:28 Dead squid remains in blotchy patches on the sea floor
14:30 The bottom has turned to all sand
14:32 The bottom is now back to large boulders with san patches
14:33 Large net blanketing the bottom
14:37 Line draped along the reef
14:38 The bottom is high complexity, high relief reef
14:41 There is a cable (or line) hooked on the reef
14:42 There is a chain draped along the bottom
14:44 Another chain draped along the bottom

Dive name: 12-295B (Point 29)
Start time: 14:53 **End time:** 15:08
Notes: Breezy (~7 kt) with moderate swell (1-3') with some surface chop. Cloudy with drizzle. High complexity reef with boulders and intermittent sand patches.
Observations:
14:53 Adult *S. levis*
14:55 Larger sand patches and less complexity
14:57 Debris (line)
12:59 Bucket
15:00 Sand, occasional boulders/reef with many small fish
15:03 All sand

Dive name: 12-295C (Point 31)
Start time: 15:46 **End time:** 16:05
Notes: wind 12 kt swell increasing, white caps starting to form, cloudy and drizzle. Large boulders, gnarly complex reef, tracking has been bad since the beginning of transect.
Observations:
15:51 Longline
15:48 Adult *S. levis*
15:55 Adult *S. levis*
15:57 Adult *S. levis*

Dive name: 12-295D (Point 25)
Start time: 16:52 **End time:** 17:20
Notes: Blustery. Wind ~15 kt, seas 1 m with short period (choppy). Cloudy with drizzle. The bottom is boulder with small intermittent sand patches. Depth 90-100 m.
Observations: No *S. levis*
16:54 Sand
16:57 Loose clusters of boulders/cobble

17:00 Large boulders
17:00 *Lophelia*; depth 100 m
17:03 Large cluster of *Lophelia*, depth 100 m
17:06 Off effort
17:09 On effort
17:09 Sand and crinoids until the end
17:14 Off effort
17:15 On effort

Following this transect, wind and sea conditions were deemed unsuitable for further ROV operations. The vessel returned to Seaforth landing and this leg of the survey was ended. Need to return to complete the sampling at this site.

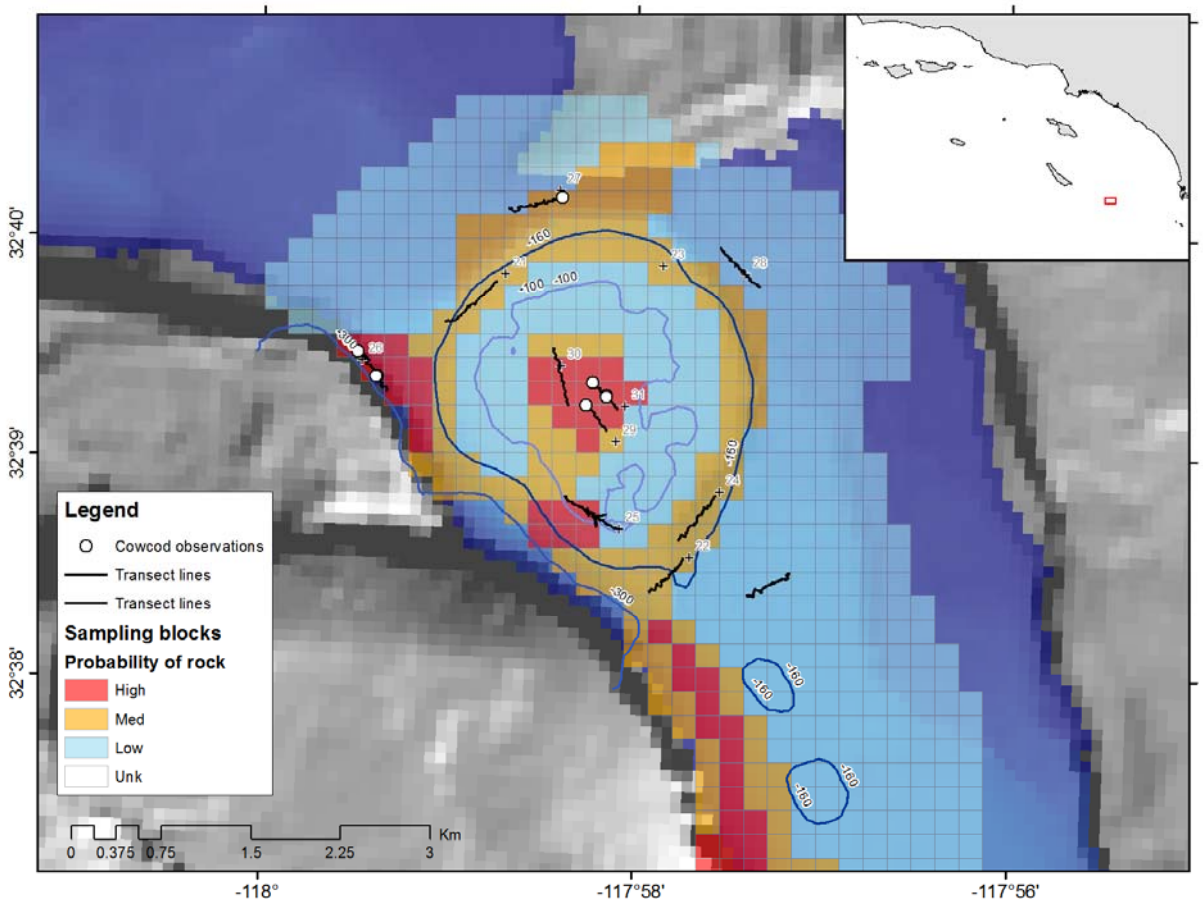

Figure 17. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from 43 Fathom Bank during Legs 1 and 2 (see below for notes from Leg 2 transects).

10.2 Leg 2 (October 29-30, 2012)

Day 13: 43 Fathom Bank
10/29/2012 (Mon)

14:47-23:53 Surveyed the remainder of the 43 Fathom Bank (**Figure 17**, see Leg 1 above), including a few areas of interest to G. Cutter for seabed classification.

Dive name: 12-303A (Point 27)
Start time: 14:47 **End time:** 15:15
Notes: Flat calm seas with little or no wind. Sand bottom with snail fish, lots of stars and pink urchins, small amount of net, starting to see some small cobble, few scattered boulder. Tracking of the ROV was poor for most of the transect, and seems to be unassociated with the motion of the ship.
Observations:
15:12 Adult *S. levis* resting on a small, isolated rock patch

Dive name: 12-303B (Point 21)
Start time: 16:15 **End time:** 16:43
Notes: Seas calm with a thick marine layer. Mostly sloped sandy seabed with few critters. No *S. levis*. Line suspended in water at 100 m as we came up from transect. A lot of flickering in the video signal, Disconnected the tether following the transect to remove several turns that may be to blame.
Observations: No *S. levis*

Dive name: 12-303C (Point 26)
Start time: 17:59 **End time:** 18:33
Notes: The seas are nearly flat with slight texture on the surface. The bottom is highly sloped hard substrate covered with sand and cobble/boulder (Low to moderate complexity). Depth is 270-280 m.
Observations:
18:08 There are not really any fish here. There are a few single *S. ensifer*
18:10 There is an east-west ledge along the slope here and many more fish
18:10 There is a large adult *S. levis* next to a small ledge
18:12 There is another large adult *S. levis* next to the ledge
18:16 Giant Pacific octopus
18:29 This section of the reef is more complex, but there are still very few fish on this entire transect
18:30 Adult *S. levis* (gravid)
18:32 Giant Pacific octopus

Dive name: 12-303D (Point 24)
Start time: 19:53 **End time:** 20:15
Notes: Sand bottom with crinoids, hatchling rays.
Observations: No *S. levis*

*****Transited underwater to the beginning of the next transect. Distinct shift in seabed type while crossing the yellow/brown to orange/green/brown portion of Cutter's seabed map.***

Dive name: 12-303E (Point 22)
Start time: 20:27 **End time:** 20:48
Notes: Cobble with a lot of crinoids, *S. semicinctus*, *S. ensifer*, *S. rufus*. Distinct shift in the seabed from cobble to larger boulders and complex reef between brown and blue seabed types.
Observations: No *S. levis*

Dive name: 12-303F (Point 28)
Start time: 21:45 **End time:** 22:10
Notes: The sea is calm. There is a slight swell increase and light wind texture on the surface. The bottom is mostly sand with sea stars at the start. There were not really any fish on this transect. A few small flatfish.
Observations: No *S. levis*

Dive name: 12-303G (Point less)
Start time: 23:17 End **time:** 23:53
Notes: Lost control system on the way down. Mostly cobble bottom with sand, *S. ensifer*, *S. semicinctus*. Boulders on bottom. *S. chlorostictus*, dense small boulders.
Observations: No *S. levis*
23:21 Off effort
23:22 On effort
23:28 *Antipathes*

Completed surveying 43 Fathom Bank, and now transiting to Cortes Bank (North).

Day 14: Cortes Bank (North)
10/30/2012 (Tue)

14:33-19:52 Surveyed Cortes Bank (North) (**Figure 18**)

Dive name: 12-304A (Point 82)
Start time: 14:33 **End time:** 15:07
Notes: Seas are flat calm with 0.5-1 m swell. No wind to speak of. The bottom is nearly equal sand and cobble with some brittle stars. Fish observations include *Sebastomus* spp., *S. chlorostictus*, and *S. elongatus*. There are medium to large schools of halfbanded rockfish. The bottom switched to mostly cobble and very small boulders around 14:40. Some *S. wilsoni*. Changed to large cobble with small boulders around 14:50. Large, coiled stainless cable flat on the seabed around 14:58. Moderate hazard. Large schools of *S. hopkinsi* and mixed small rockfishes at the end. Getting into some higher complexity reef at the end of the transect.
Observations: No *S. levis*

Dive name: 12-304B (Point 86)
Start time: 15:52 **End time:** 16:21
Notes: Good operating conditions. Seas are calm (0.5-1 m swell) with a slight increase in swell and a little surface texture. The bottom is slightly sloped wavy sand. The fish observations include *S. chlorostictus, S. constellatus, S. ensifer, S. hopkinsi, and S. paucispinis*. In general, there are not many fish here.
Observations:
15:58 The bottom has turned from sand to dense cobble; it looks like hard substrate covered with cobble and occasional boulders

16:09 Bottom type is now moderate complexity reef with cobble. The bottom has become a little more complex, but very few fish.
16:16 Adult *S. levis* resting on the bottom
16:18 The bottom is now sections of high complexity reef and some larger fish observations.
16:20 Adult *S. levis* next to a ledge in reef

Dive name: 12-303C (Point 83)
Start time: 16:54 **End time:** 17:26
Notes: Boulder field with some bigger boulders, went down to sand patch, then to cobble field with sand, small rockfish, old beer can, *S. jordani*, pockets of pebbles,
Observations:
16:55 Adult *S. levis* gravid near bigger boulder
17:22 Adult *S. levis* in depression of small boulders

Dive name: 12-304D (Point 88)
Start time: 18:19 **End time:** 18:44
Notes: Seas still calm with 1-2' swell and little wind. Scattered clouds. Seabed all sand with a lot of basket stars, poachers, and combfish. A lot of swarms of small shrimp. Zoomed-in on HD video camera at 18:23. Kirk Sato practiced driving over the sandy patches.
Observations: No *S. levis*

Dive name: 12-304E (point 87)
Start time: 19:44 **End time:** 19:52
Notes: Excellent operating conditions. Small long period swell and very light wind. The bottom is predominately sand *S. ovalis* with small boulders and cobble. Fish observations include *S. semicinctus, S. elongatus*, flatfish, *S. chlorostictus, S. constellatus, S. rufus*, one adult *S. levis* just before vehicle died.
Observations:
19:49 Adult *S. levis* that went behind a large rock; visible for measuring on the back side of the rock
19:51 *Lophelia*

*****Lost controls and video after about 10 minutes. Had to recover a dead ROV. No obvious tight bends or compromised portions of the tether upon initial inspection. Testing the tether through the deck whip using the OTDR.*****

*****Tests using the OTDR indicates that all three optical fibers are compromised approximately 45-50 m from the subsea termination. All tests inside the electronics bottle suggest that all systems are operating properly.***

*****Replaced the HD camera whip while electronics bottle was removed.***

10/31/2012 (Fri)
Returned to Seaforth Landing to swap tethers. Upon reattaching the tether, the video continuously flickered and was unable to be reconciled. Re-insulated many of the digital components of the video system to no avail.

11/1/2012 (Fri)
Continued testing of various video components. Swapped Rattler units. Relocated Rattlers within the electronics bottle. Eliminated HD/SDI connections in the J-box. Reconnected HD/SDI cables in the electronics bottle. The cause of the video was isolated to the HD/SDI output - BNC connection of the AJA component to HD/SDI convertor inside the electronics bottle. One of the BNC junctions for the HD/SDI signal inside the topside J-box also seemed suspect. The video problems appeared to be fixed by the end of the day. Tested the ROV at the bait barge and all tests went well. Finished preparing the ROV for the next leg of the cruise.

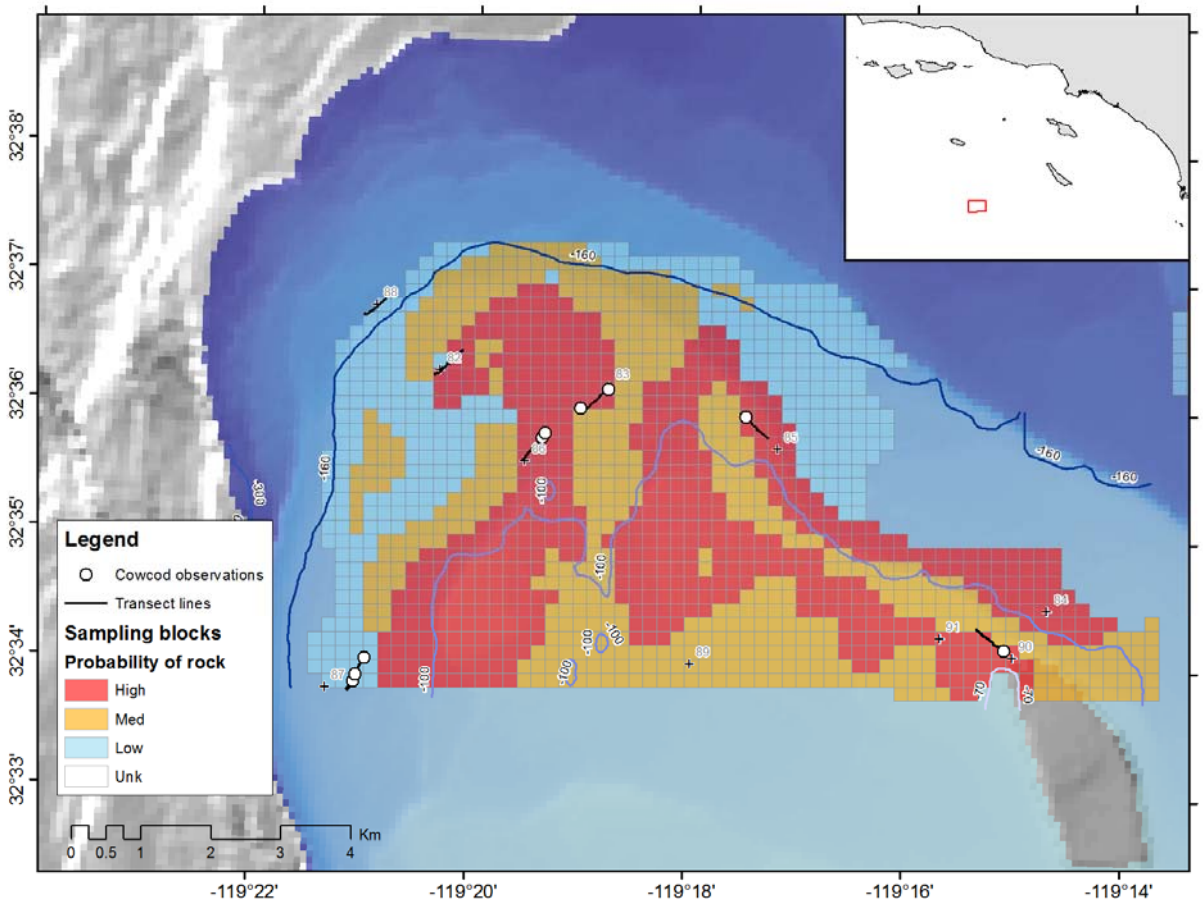

Figure 18. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from Cortes Bank (North).

10.3 Leg 3 (November 4-November 8, 2012)

Day 15: Cortes Bank (North, cont.)
11/4/2012 (Sun)

21:55-01:04 (11/4/2012) Surveyed the remainder of Cortes Bank (North) (**Figure 18**, see Leg 2 above)

Video flickering badly during the first deployment. Did not get any better upon reaching the bottom. The transect was terminated prematurely due to poor video while in high-relief habitat. After lots of troubleshooting of the topside and subsea video signal, the culprit seemed to be a faulty connection with the AJA component-to-HD/SDI video converter inside the electronics bottle of the ROV. The coax cable coming out of the converter had a tight bend that was eliminated, and the BNC connector was reseated and secured at this location. The ROV system was put back together and functioning very well. The HD video signal does have some "noise", but the signal strength is good and not flickering. The noise is likely from electrical induction on the component cables inside the electronics bottle.

Dive name: 12-309A (Point 87)
Start time: 21:55 **End time:** 22:27
Notes: Re-surveyed same area as 12-304E. The sea state is calm winds and long period small swell. These are excellent operating conditions. The bottom is mostly sand with sparse cobble and intermittent boulders. The ROV system is functioning very well.
Observations:
21:56 Adult *S. levis*
22:02 Line off the bottom
22:03 *Lophelia*
22:11 Adult *S. levis*

Dive name: 12-309B (Point 85)
Start time: 23:21 **End time:** 23:48
Notes: Small boulders, boulder field getting more complex with bigger boulders. Good visibility and little current. They appear to be sitting on top of pavement reef. Yellow hose.
Observations:
23:26 Adult *S. levis* (35-40 cm)

Dive name: 12-309C (Point 90)
Start time: 00:44 **End time:** 01:04
Notes: Seas are calm with a slight breeze. Seabed is large boulders and reef with some sand in between. A lot of *S. paucispinis* on the bottom at the beginning of the transect. Not many other fishes at all.
Observations:
01:02 Juvenile *S. levis* (~20 cm)

Completed surveying Cortes Bank (North). Anchoring on Cortes Bank for the evening.

Day 16: Cortes Bank (Mid)
11/5/2012 (Mon)

14:50-23:55 Surveyed Cortes Bank (Mid) (**Figure 19**)

Dive name: 12-310A (Point 73)
Start time: 14:50 **End time:** 15:20
Notes: Excellent operating conditions. Long period 0.5-1 m swell and no wind. The bottom is sandy covered with pebbles. Fish observations include *S. elongatus, S. chlorostictus, S. ensifer, S. wilsoni, S. paucispinis*, flatfish, *S. semicinctus, S. levis, S. hopkinsi.*
Observations:
14:53 The bottom has turned to low complexity reef with boulders and cobble
14:57 Long line along the bottom
15:02 Adult *S. levis*
15:04 The bottom is now back to sand/pebble with intermittent boulders/cobble patches
15:12 Adult *S. levis* (gravid) hunkered behind a small boulder
15:17 Adult *S. levis* resting on bottom
15:18 Adult *S. levis*; moved into the reef before we could get measurement lasers on the fish

*****Transit along bottom to the start of the next transect.***

Dive name: 12-310B (Point 76)
Start time: 15:33 **End time:** 15:52
Notes: Excellent operating conditions. Long period 3-4' swell and very light wind texture on the surface. The bottom is sand, later small boulder patches with slumping mud, followed by sand, more scattered small boulders. Back to pure sand.
Observations: No *S. levis*

Dive name: 12-310C (Point 74)
Start time: 16:39 **End time:** 16:58
Notes: Seas glassy with no wind and minimal swell. Very warm outside. Seabed mixed with cobble and sand. Entered an interesting area with large mud/sand mounds and patchy cobble. Later switched to bare sand with medium-sized sand waves (20-40 cm).
Observations: No *S. levis*

Dive name: 12-310D (Non-random deep transect)
Start time: 18:01 **End time:** 18:24
Notes: Seabed mostly sandy with a moderate slope and a lot of *Pycnopodia* and pink urchins. There was a large group of *S. miniatus* and the bottom turned to high complexity step slop (rock wall face). Bottom is back to moderate sloped sand. Difficult to keep the ROV on the bottom and run an effective transect, largely due to poor tracking at times.
Observations:
18:08 Adult *S. levis*
18:20 *Lophelia*
18:20 The bottom turned to high complexity boulders/reef and a very steep slope that drops off.

Dive name: 12-310E (Point 80)
Start time: 19:23 **End time:** 19:44
Notes: Large boulders and reef. Boulders with sand, large sand channels, boulders with sand, rounded reef, pavement reef.
Observations:
19:36 Juvenile *S. levis*

Dive name: 12-310F (Point 78)
Start time: 20:41 **End time:** 20:58
Notes: Seas calm with no wind. 1-1.5 m swell. All sand bottom with small sand waves and a lot of sea urchins.
Observations: No *S. levis*

Dive name: 12-310G (non-random transect)
Start time: 22:10 **End time:** 22:35
Notes: Seas have increased to 4-6 ft, very long interval, no wind. Excellent operating conditions. The bottom is initially sand with cobble patches.
Observations:
22:14 The bottom is cobble
22:15 There are lots of small fish (*S. wilsoni*) but no large fish
22:21 Juvenile *S. levis*
22:24 The bottom is boulder/cobble

Dive name: 12-310H (non-random deep transect)
Start time: 23:33 **End time:** 23:55
Notes: Sandy slope, very few fish on transect.
Observations: No *S. levis*

Completed surveying Cortes Bank (Mid). Anchoring on Tanner Bank for the evening.

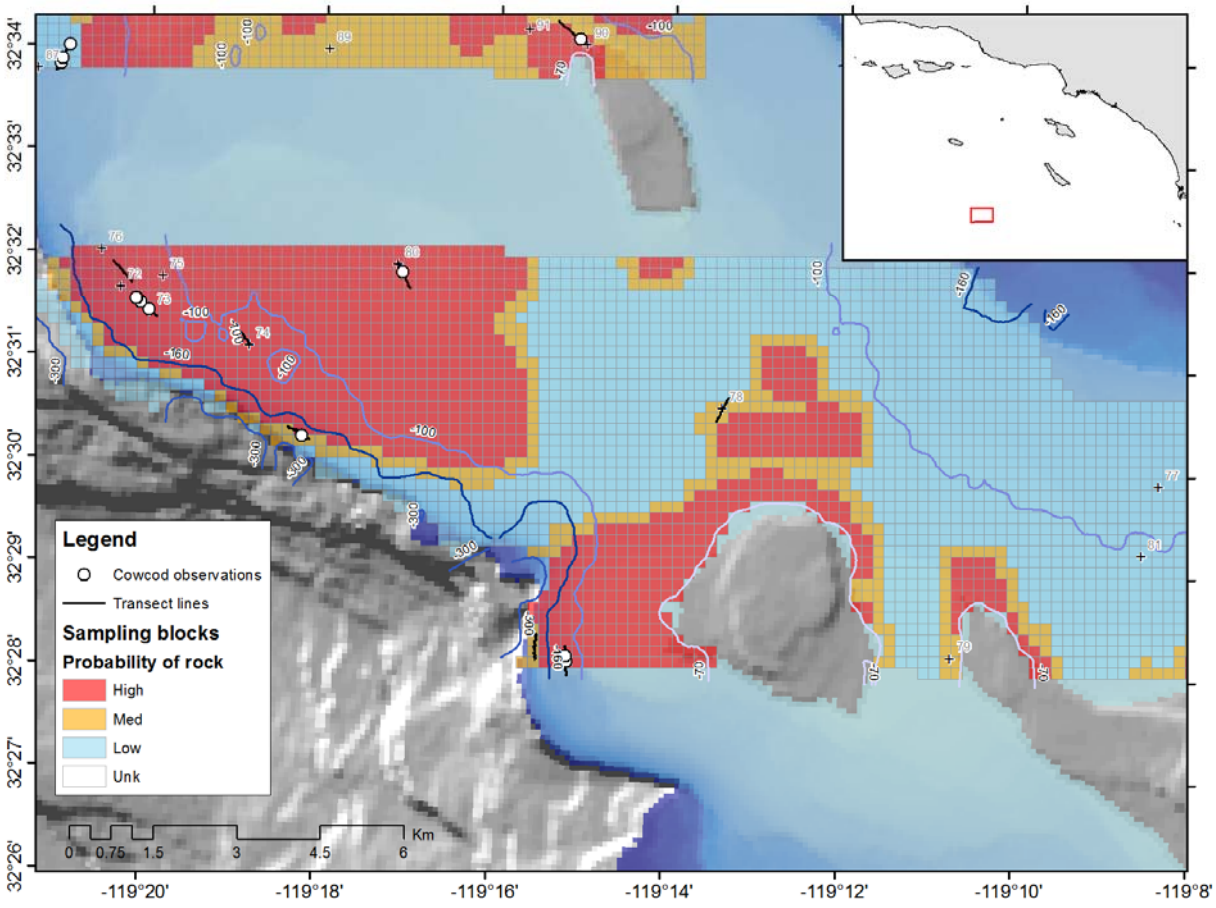

Figure 19. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from mid-Cortes Bank.

Day 17: Tanner Bank
11/6/2012 (Tue)

14:37-00:11 (11/7/2012) Surveyed Tanner Bank (**Figure 20**)

Dive name: 12-311A (Point 283)
Start time: 14:37 **End time:** 15:08
Notes: Good operating conditions, with a slight breeze and minimal swell. Seabed all sand at the start of the transect. Very few fish. A few flatfish and some octopus. The seabed was moderately sloped sand for the entire transect. Almost no fish observed.
Observations: No *S. levis*

Dive name: 12-311B (Point 282)
Start time: 15:59 **End time:** 16:27
Notes: Good operating conditions. Moderate 0.5-1 m swell with ~5-8 kt of breeze. The bottom is hard substrate with sand patches and a low to moderate amount of both small and large fish.
Observations: No *S. levis*
16:16 High relief, more complex section of the reef with large school of fish

Dive name: 12-311C (Point 287)
Start time: 17:12 **End time:** 17:42
Notes: Good operating conditions. Moderate 1-1.5 m swell with ~5-8 kt of breeze. Big reef ledges, Broken pavement reef with boulder, finger reef with deep crevasses, reef 2 m tall with large overhangs, and deep crevasses, lots of rockfish on top, bigger rockfish in the crevasses, top of reef pavement reef, flat with lots of crinoids, sand channel followed by more stepped pavement reef
Observations:
17:19 Adult *S. levis*
17:29 Adult *S. levis*

Dive name: 12-311D (Point 284)
Start time: 18:41 **End time:** 19:11
Notes: Good operating conditions. Moderate 1-1.5 m swell with ~5-8 kt of breeze. Bottom mostly mud with urchins and a few *S. elongatus*. Little or no slope. Transect direction not ideal for operating the ship, which is affecting the quality of the tracking system. Considering running the next transect shallower and in the opposite direction. (18:49) Changed transect direction to the south. Start video analysis at this point, and trim navigation data to start here. HD footage of eelpout near the end of the transect.
Observations: No *S. levis*

Dive name: 12-311E (Point 281)
Start time: 20:10 **End time:** 20:38
Notes: Good operating conditions. Moderate 3-4' swell with ~5-8 kt of breeze. The bottom is sandy with spaced out cobble and crinoids.
Observations:
20:14 Juvenile *S. levis* (YOY)

Dive name: 12-311F (Non-random transect on the SE portion of the Bank)
Start time: 21:42 **End time:** 22:14
Notes: Large boulders stacked with intermittent sand, down sand slope, some small piles of large boulders then sand, large boulders, video blinked a few times.
Observations:

21:43 Possible *S. levis* (no lasers)
21:45 *S. levis*; no lasers
21:49 *S. levis*
21:49 *S. levis*
21:50 *S. levis*
22:12 *S. levis* (35-40 cm)
22:13 *S. levis*

*****Transit along bottom to the next transect point.***

Dive name: 12-311G (Non-random transect on the SE portion of the Bank)
Start time: 22:32 **End time:** 23:05
Notes: Wind has picked-up somewhat, with 5-10 kt breeze. Mixed seabed throughout. Mostly hard bottom with cobble and large boulders interspersed with some sand patches. Many fishes, including lots of *S. paucispinis* and dense schools of *S. hopkinsi*, halfbanded, *S. wilsoni*, etc. Some current on the bottom made it difficult to fly straight at times. Changed to sand with cobble and crinoids around 22:55. Lots of *S. rubrivinctus* toward the end of the transect.
Observations:

22:41 Adult *S. levis*; difficult to measure
22:50 Adult *S. levis*
22:57 Adult *S. levis*
23:01 Adult *S. levis*
23:02 Gravid female *S. levis*
23:03 Adult *S. levis*

Dive name: 12-311H (Non-random point near Point 286)
Start time: 23:49 **End time:** 00:11
Notes: Moderate swell with some wind chop. The bottom is mostly sand.
Observations: No *S. levis*

Completed surveying Tanner Bank. Anchoring on Tanner Bank for the evening.

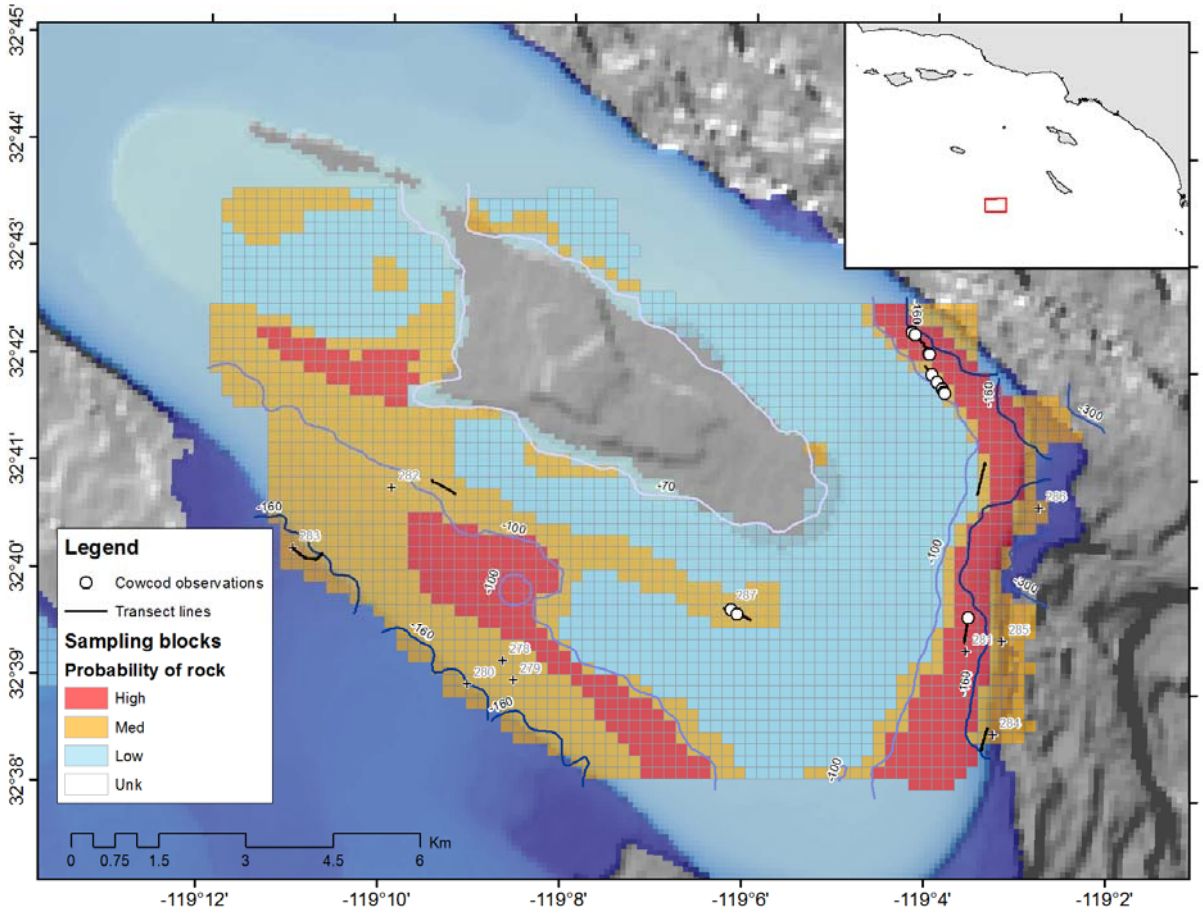

Figure 20. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from Tanner Bank.

Day 18: Cortes Spawning Grounds
11/7/2012 (Wed)

14:37-01:31 (11/8/2012) Surveyed the Cortes Spawning Grounds (**Figure 21**)

Dive name: 12-312A (Point 97)
Start time: 14:37 **End time:** 15:03
Notes: Seas and wind are up today. Wind 5-10 kt with 1.5-2 m swell. Cobble with boulders, lots of *S. ensifer*, *S. semicinctus*, cobble. Video blinking more frequently today, but no obvious causes (e.g., no tight bends in the tether).
Observations:
14:39 Adult *S. levis*
14:40 Adult *S. levis*
14:41 Juvenile *S. levis*
15:01 Adult *S. levis*

Dive name: 12-312B (Point 98)
Start time: 15:47 **End time:** 16:11
Notes: Seas and wind building.1-2 m swell and winds 5-10 kt but still operable conditions. Seabed mostly sand/mud at the beginning with some gravel patches. Switched to sand with cobble (15:52). More blinking in the video, but not as frequent as the previous transect. *S. chlorostictus* and *S. ensifer* present. Interesting mounds of mud, cobble, and flat reef (16:00). Large patch of pebbles around 16:08, then switching back to cobble.
Observations: No *S. levis*

*****Transited to the SW bank of the Cortes Spawning Grounds. Attempting to complete two transects at each of the three smaller banks before the weather becomes inoperable, and will return to conduct additional transects if possible.***

Dive name: 12-312C (Point 108)
Start time: 17:08 **End time:** 17:37
Notes: Seas are 1-2 m, winds are 5-10 kt. The bottom is covered with cobble and crinoids.
Observations:
17:22 Juvenile *S. levis*

Dive name: 12-312D (Point 111)
Start time: 18:35 **End time:** 18:57
Notes: Sand with boulders, hake, sponges, *S. elongatus*, *S. rubrivinctus*, *S. ensifer*
Observations: No *S. levis*

Dive name: 12-312E (Point 112)
Start time: 20:04 **End time:** 20:28
Notes: Mostly sandy/muddy seabed with sponges and basket stars.
Observations: No *S. levis*

Dive name: 12-312F (Point 109)
Start time: 21:52 **End time:** 22:23
Notes: The sea state is swell 4-6', winds 10 kt. The bottom is cobble with abundant crinoids and brittle stars. *****The tracking system was not tracking the ROV when first deployed on transect 12-312F. The vehicle was recovered and the smaller, spare TrackLink transponder (same as on the clump weight) was fixed to the ROV frame, and settings were adjusted in the TrackLink and WinFrog programs to recognize the new transponder. The vehicle was deployed again and tracking worked well. After the swap, tracking was still not great due to the direction of the transect, but it was adequate to complete the survey.***

Observations:
22:04 Juvenile *S. levis*
22:16 Juvenile *S. levis* (probably YOY)
22:20 Adult *S. levis*
22:22 Adult *S. levis*

Dive name: 12-312G (Point 107)
Start time: 23:19 **End time:** 23:45
Notes: Boulders and cobble, surface conditions getting worse. The wind is here. Sand.
Observations:
23:21 Juvenile *S. levis*

Dive name: 12-312H (Point 103)
Start time: 00:27 **End time:** 00:55
Notes: Swell has diminished somewhat, but the wind is still making for choppy conditions. Mostly cobble seabed with crinoids and brittle stars. Not a lot of fishes, but some *S. ensifer*, *S. wilsoni*, and *S. jordani*. The HD video of the ROV has flickered out a few times during the transect.
Observations:
00:50 Juvenile *S. levis*

*****Transit along bottom to the next transect point.***

Dive name: 12-312I (Point 106)
Start time: 01:07 **End time:** 01:31
Notes: Swell is 3-5' and winds are 10-15 kt. The bottom is cobble. *S. jordani*, small *S. rufus*, and *S. ensifer* are abundant. Four adult *S. levis*, three right at the end of the transect.
Observations:
01:21 Adult *S. levis*
01:31 Adult *S. levis*
01:31 Adult *S. levis*
01:31 Adult *S. levis*

Completed surveying Cortes Spawning Grounds. Transiting to 9 Mile Bank overnight.

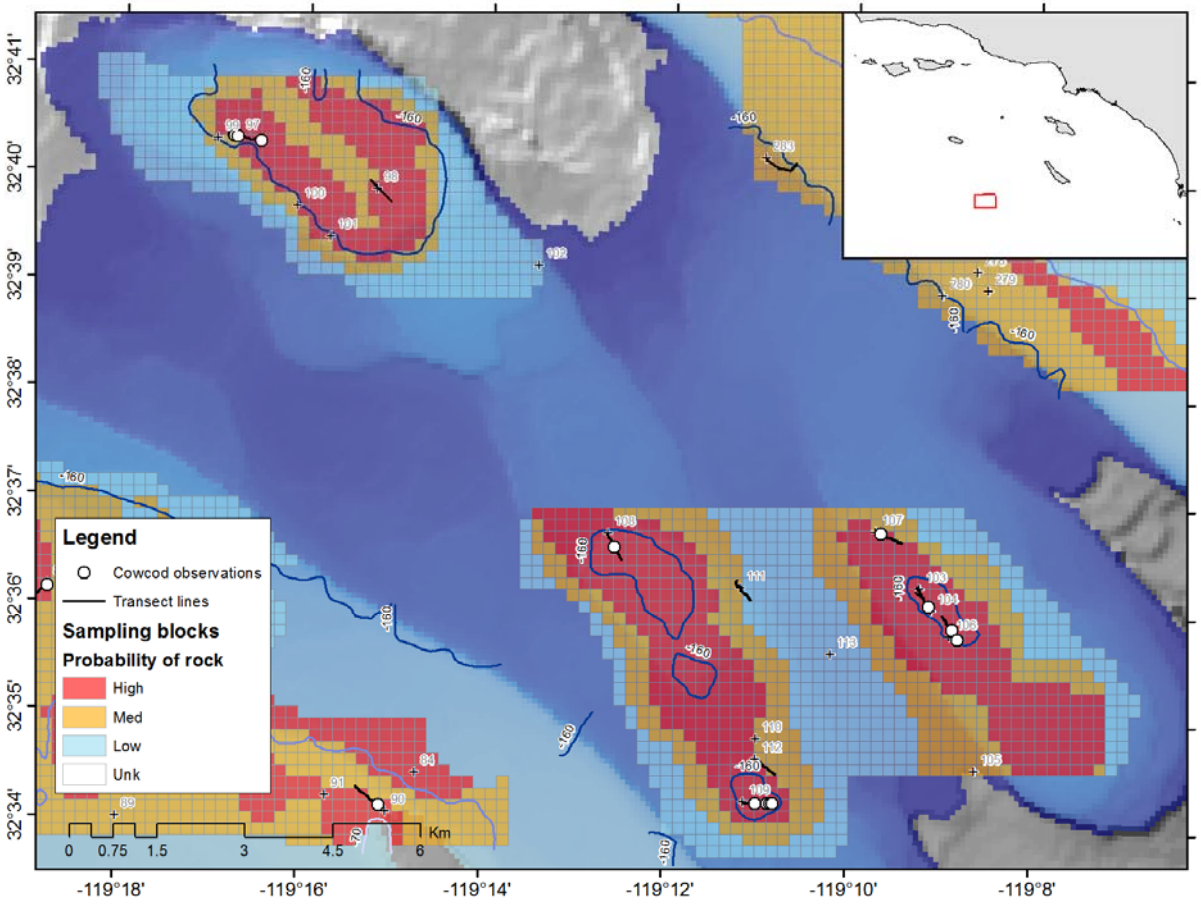

Figure 21. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from the Cortes Spawning Grounds.

Day 19: 9 Mile Bank
11/8/2012 (Thu)

14:48-01:11 (11/9/2012) Surveyed 9 Mile Bank (**Figure 22**).

Dive name: 12-313A (Non-random point on the NW of the bank)
Start time: 14:48 **End time:** 15:21
Notes: Surface conditions are good with small swell and a little wind. Mud bottom with PVC pipe all over the ground, cobble and small boulders in mud, medium boulders in mud, *S. wilsoni*, *S. rufus, S. elongatus*, lots of market squid coming down to check out the ROV.
Observations: No *S. levis*

Dive name: 12-313B (Point 47)
Start time: 16:39 **End time:** 17:02
Notes: Seas calm with minimal swell and wind. Seabed mostly sand with cobble. Lots of basket stars, sea stars, and urchins. flatfishes, *S. semicinctus* and *S. saxicola* at the beginning.
Observations: No *S. levis*

Dive name: 12-313C (Point 50)
Start time: 17:50 **End time:** 18:13
Notes: Seas are 0.5-1 m swell with 5-10 kt of breeze. Other than a fair amount of current, these are good operating conditions. Moderately sloped sand bottom. The depth is ~200 m. There were only a few small fish observed.
Observations: No *S. levis*
17:55 There is an odd projectile canister on the ocean floor.

*****Transit along bottom to the next transect point.***

Dive name: 12-313D (Point 48)
Start time: 18:23 **End time:** 18:45
Notes: sand slope with sparse cobble and boulders, some pavement reef, then down to sand.
Observations: No *S. levis*
18:41 Big pile of mono and a cable

*****Transit along bottom, up slope, to the next transect point. Entered cobble and small boulder substrate during the transit.***

Dive name: 12-313E (Point 43)
Start time: 18:58 **End time:** 19:34
Notes: Seabed mostly cobble to start, then switched to medium and large boulders. Not a lot of fish, in general.
Observations:
19:01 Adult *S. levis*

Dive name: 12-313F (Point 44)
Start time: 20:21 **End time:** 20:59
Notes: Seas are 0.5-1 m with 5-10 kt of breeze. The seabed is cobble and small boulders with sand patches. Only a few small fish on this transect.
Observations: No *S. levis*

Dive name: 12-313G (Point 46)
Start time: 21:44 **End time:** 22:10
Notes: Muddy slope with cobble and small boulders, no OnLocation for this transect.
Observations: No *S. levis*

Dive name: 12-313H (Perch Rock, near Mexican border)
Start time: 23:15 **End time:** 23:34
Notes: Mostly sandy at the beginning of the transect with few fishes. *S. semicinctus* and some sand dabs. Changed to large boulders around 23:26, and quickly spotted five *S. levis*.
Observations: Five *S. levis* observed in one cluster during this transect.
23:27 Adult *S. levis*
23:28 Adult *S. levis***;** no lasers on this fish
23:28 Adult *S. levis*
23:28 Adult *S. levis*
23:28 Adult *S. levis***;** no lasers on this fish

Dive name: 12-313I (Non-random point on the E side of the bank)
Start time: 00:41 **End time:** 01:11
Notes: Seas remain workable, with moderate swell and not much chop. Overcast and cool with a slight breeze, but worse weather is on the horizon. The bottom is cobble and small boulders. Only a few small fish on this transect. The HD video continues to drop signal on occasion.
Observations: No *S. levis*

Completed surveying 9 Mile Bank, and now transiting to Seaforth Landing. End of Leg 3.

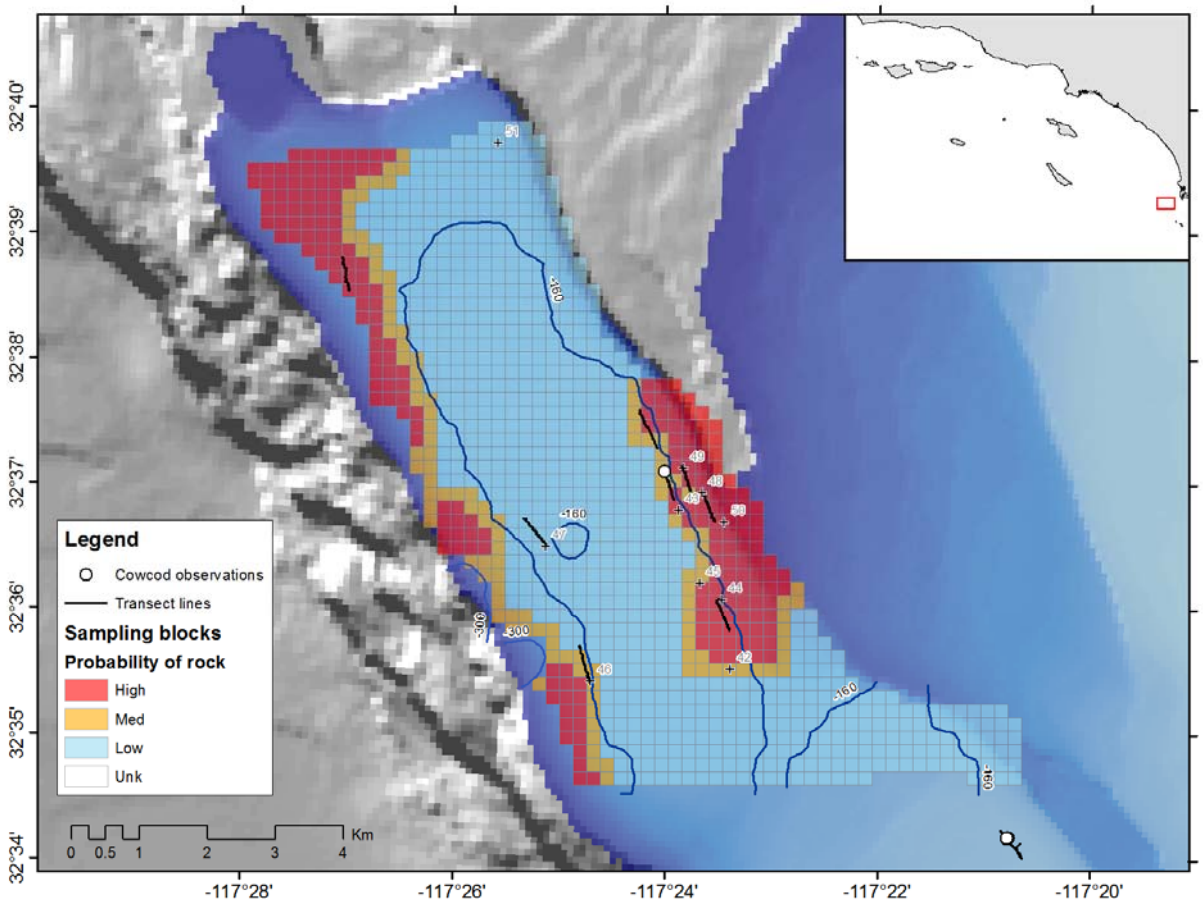

Figure 22. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from 9 Mile Bank.

10.4 Leg 4 (December 8- 13, 2012)

Day 20: S San Clemente Island (SHOBA)
12/08/2012 (Sat)

15:11-00:44 (12/9/2012) Surveyed San Clemente Island (**Figure 23**)

Dive name: 12-343A (Point 208)
Start time: 15:11 **End time:** 15:35
Notes: Surface conditions calm, sandy bottom, some sand dabs, octopus, squid
Observations: No *S. levis*

Dive name: 12-343B (Point 202)
Start time: 16:23 **End time:** 16:50
Notes: Calm surface, sandy bottom, lots of urchins/sea stars
Observations: No *S. levis*

Dive name: 12-343C (Point 205)
Start time: 17:33 **End time:** 18:00
Notes: Calm surface, sandy bottom with crinoids and brachiopods, several small octopus, pebble and sand habitat at 17:38, returns to sand at 17:43, 17:45 stray cable, sparse rocks at 17:49, spotted skate, 17:58 *S. chlorostictus*
Observations: No *S. levis*

Dive name: 12-343D (China Point; Non-random)
Start time: 18:36 **End time:** 19:17
Notes: Calm surface, rocky bottom, lots of small fish, going into small current, sponges, ray. A lot of small rockfishes around 19:09.
Observations:
18:43 Adult *S. levis*
18:56 Adult *S. levis*

Dive name: 12-343E (Point 204)
Start time: 20:13 **End time:** 20:35
Notes: Sandy bottom with some crinoids, ratfish, small octopuses, pebbles at 20:30, small rockfish at 20:33
Observations: No *S. levis*

Dive name: 12-343F (Point 211)
Start time: 22:08 **End time:** 22:32
Notes: Sandy bottom with urchins and sea stars. Some crabs.
Observations: No *S. levis*

Dive name: 12-12-343G (Point 220)
Start time: 23:15 **End time:** 23:35
Notes: Sandy bottom with sea stars and urchins, cucumbers, several small octopus.
Observations: No *S. levis*

Dive name: 12-343H (Point 216)
Start time: 00;23 **End time:** 00:44
Notes: Deeper transect over mostly sand or pebble bottom. Lots of urchins and crabs but not much else. One hake toward the end of the transect.
Observations: No *S. levis*

Finished surveying of San Clemente Island (South) and part of San Clemente Island (West). Transiting to Cherry Bank.

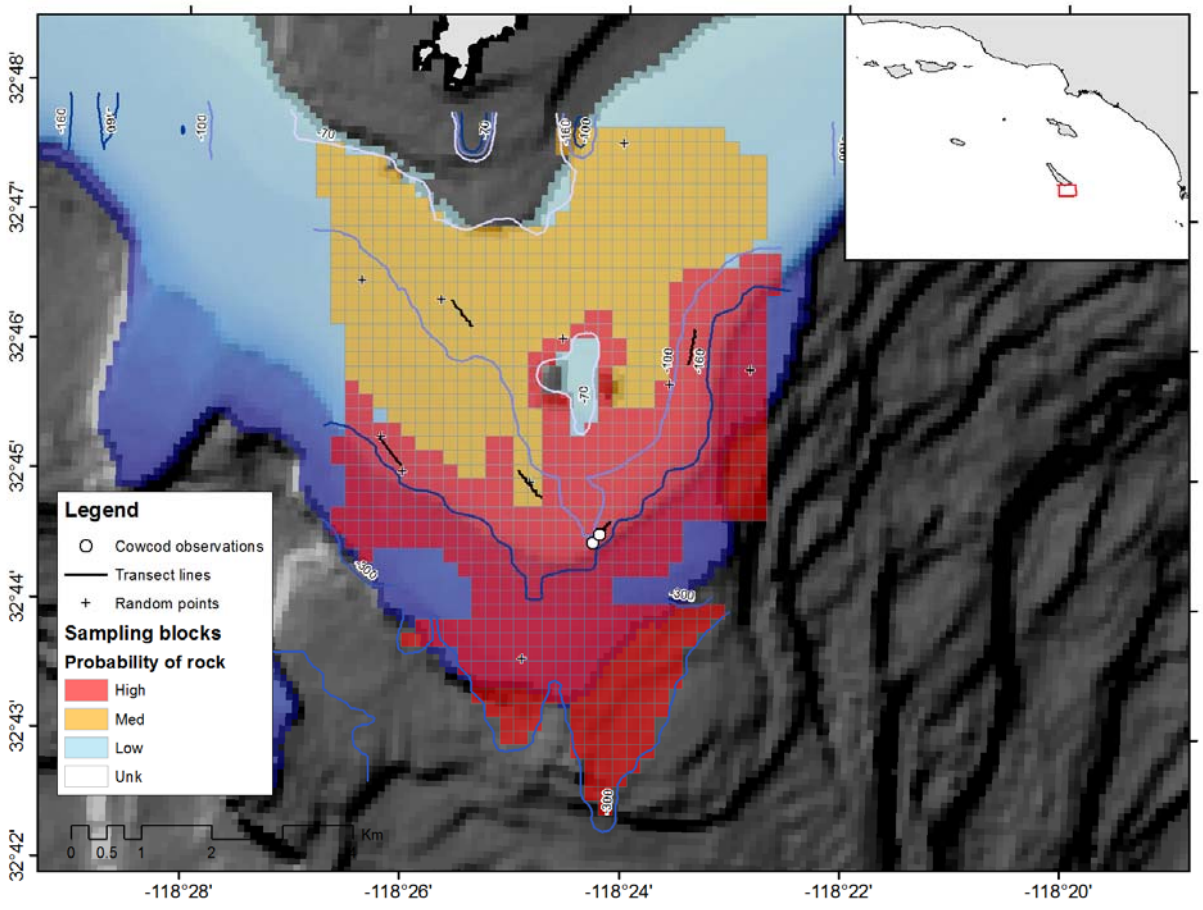

Figure 23. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from San Clemente Island.

Day 21: Cherry Bank
12/09/2012 (Sun)

15:28-00:49 (12/10/2012) Surveyed Cherry Bank (**Figure 24**)

Dive name: 12-344A (Point 66)
Start time: 15:28 **End time:** 16:00
Notes: Rocky bottom, a lot of *Lophelia*, turns to sand around 15:34
Observations: No *S. levis*

Dive name: 12-344B (Point 53)
Start time: 16:54 **End time:** 17:35
Notes: Cobbles on bottom, lots of sea stars and crinoids, lots of small rockfish, many crinoids swimming
Observations:
16:54 Juvenile *S. levis*
17:04 Adult *S. levis*
17:11 Adult *S. levis*
17:20 Adult *S. levis*
17:21 Adult *S. levis*
17:34 Adult *S. levis*

Dive name: 12-344C (Point 59)
Start time: 18:19 **End time:** 18:55
Notes: Cobbles/boulders on bottom, crinoids, and little current. Sandy patch 18:34, feather duster anemone at 18:40, large number of rockfish
Observations:
18:28 Adult *S. levis*
18:51 Adult *S. levis*

Dive name: 12-344D (Point 52)
Start time: 19:32 **End time:** 20:03
Notes: Sandy with some cobbles on bottom, turns to cobbles around 19:40, crinoids and sea stars, some small rockfish
Observations: No *S. levis*

Dive name: 12-344E (Point 62)
Start time: 20:59 **End time:** 21:24
Notes: Cobble bottom, several crabs, small rockfish, crinoids, sea stars, large fish congregation at 12:16, cable caught at 21:19
Observations: No *S. levis*

Dive name: 12-344F (Point 60)
Start time: 22:00 **End time:** 22:31
Notes: Cobble bottom, crinoids, boulders at 22:06, tangle around 22:24
Observations:
22:27 Adult *S. levis*

Dive name: 12-344G (Point 54)
Start time: 23:14 **End time:** 23:42
Notes: Cobbles on bottom, small sea fans, nudibranch at 23:17, ratfish at 23:22, hagfish at 23:29
Observations: No *S. levis*

Dive name: 12-344H (Point 54; again)
Start time: 00:23:00 **End time:** 00:49
Notes: Cobble bottom, 00:26:22 hagfish, crinoids and sea stars, mild current to the side, 00:30:23 stray pipe
Observations:
00**:**39:40 Adult *S. levis*

Transiting to San Nicolas Island (West).

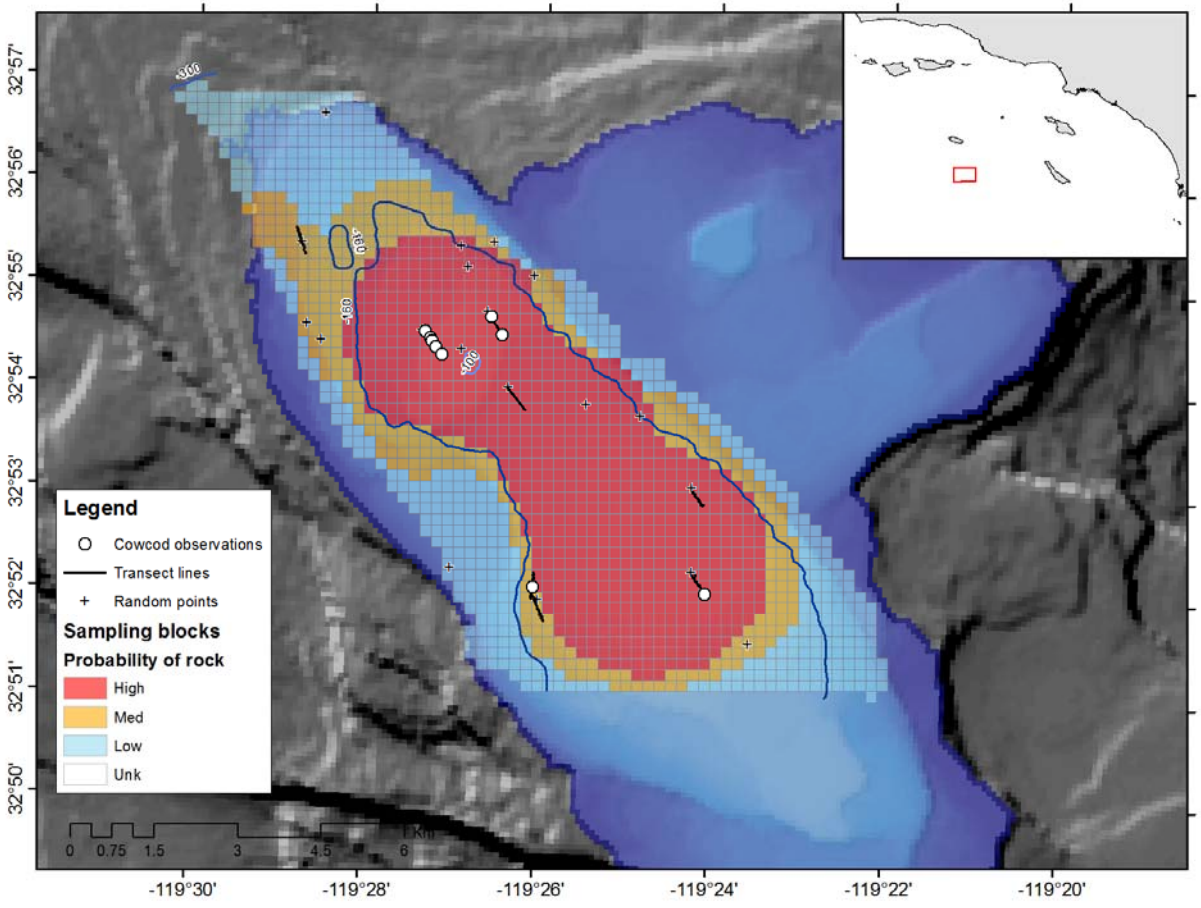

Figure 24. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from Cherry Bank.

Day 22: San Nicolas Island (West)
12/10/2012 (Mon)

14:58-00:09 (12/11/2012) Surveyed San Nicolas Island (West) (**Figure 25**)

Dive name: 12-345A (Point 248)
Start time: 14:58 **End time:** 15:25
Notes: Sandy/pebble bottom with some cobbles, several ratfish, a lot of shrimp, 15:05 crab in sponge, 15:19 large group of squid
Observations:
15:20 Adult *S. levis*

Dive name: 12-345B (Point 247)
Start time: 16:18 **End time:** 16:47
Notes: Cobble bottom with some boulders, crinoids, lots of rockfish but numbers decline as transect continues, *O. elongatus* 16:27, basket stars
Observations: No *S. levis*

Dive name: 12-345C (Point 252)
Start time: 17:40 **End time:** 18:11
Notes: Boulders on bottom, some crinoids, lots of small fish, decorator crab at 17:43, 17:55 group of tiny fish, longline at 18:01
Observations: No *S. levis*

Dive name: 12-345D (Point 244)
Start time: 18:49 **End time:** 19:19
Notes: Sandy bottom with some boulders, some crinoids, sheet rock in some places, 18:57 tons of small fish going over top of cliff, several cliffs, huge ray at 19:07, flat rock very layered
Observations: No *S. levis*

Dive name: 12-345E (Point 250)
Start time: 20:03 **End time:** 20:32
Notes: Boulders on bottom, 20:06 lost vertical, 20:09 fixed vertical, little current, 20:23 lost everything, 20:26 fixed, some small fish, vertical joystick lost connection twice during the transect.
Observations:
20:13 Adult *S. levis*; no photo
20:16 Juvenile *S. levis*; possibly no photo

Dive name: 12-345F (Point 246)
Start time: 21:28 **End time:** 21;51
Notes: Sandy, flat rock bottom, cliffs with many layers, moderate current, several rockfish all with heads pointed into current, Christmas tree worm 21:51. Replaced USB hub in the controls after this transect.
Observations: No *S. levis*

Dive name: 12-345G (Non-random transect)
Start time: 22:26 **End time:** 22:51
Notes: Sandy bottom over flat rock, a few large rocks, 22:39 large boulder with coral, small rockfish, a few cliffs, skate 22:51
Observations: No *S. levis*

Dive name: 12-345H (Point 245)
Start time: 23:38 **End time:** 00:09
Notes: Boulders on bottom, lots of small rockfish, sea stars, 00:06:20 hagfish.
Observations:
23:46 Adult *S. levis*

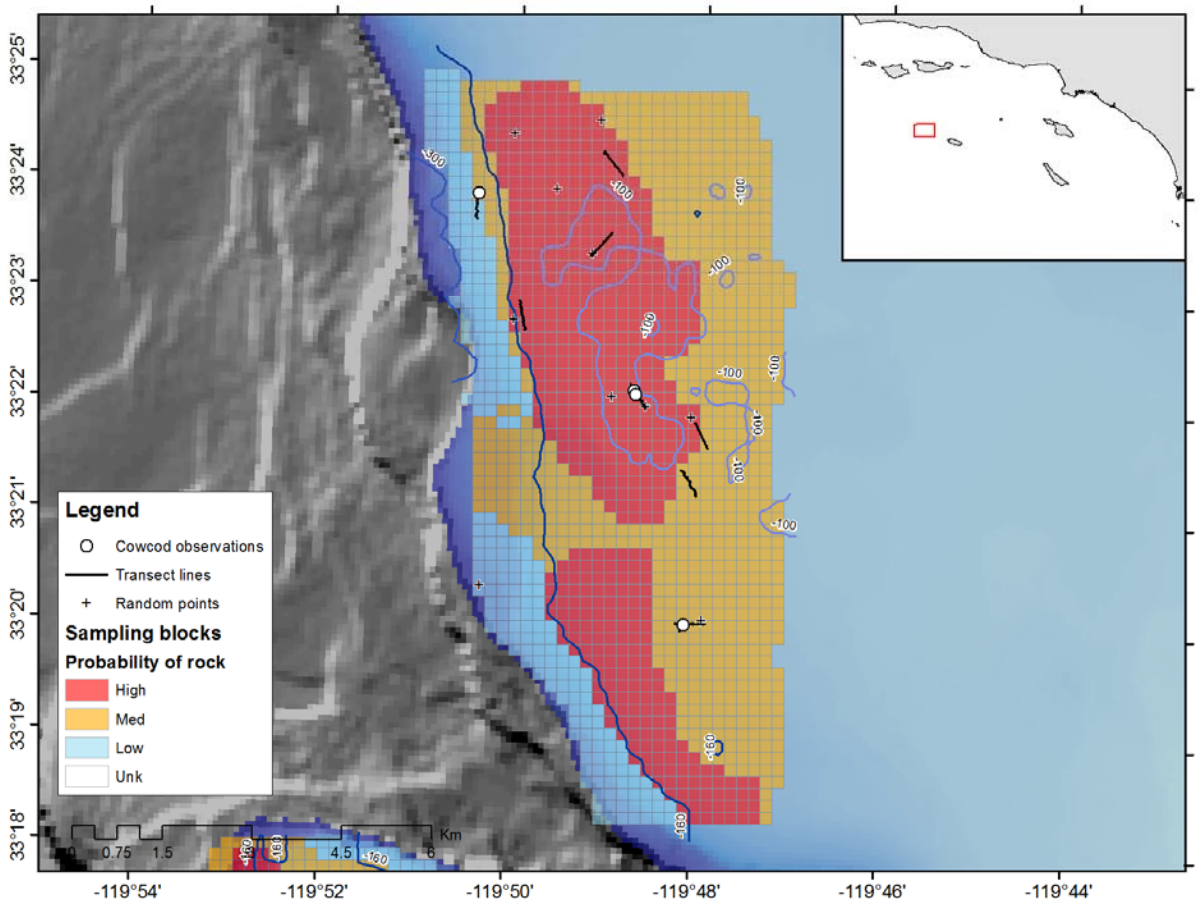

Figure 25. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from San Nicolas Island (West).

Day 23: San Nicolas Island (North)
12/11/2012 (Tue)

15:03-01:05 (12/12/2012) Surveyed San Nicolas Island (North) (**Figure 26**)

Dive name: 12-346A (Point 235)
Start time: 15:03 **End time:** 15:39
Notes: Boulders on bottom, some sandy patches, relatively few fish, nudibranch 15:17, *O. elongatus* 15:25
Observations: No *S. levis*

Dive name: 12-346B (Point 236)
Start time: 16:24 **End time:** 16:48
Notes: Cobbles/boulders on bottom, slight current, sandy patches, small rockfish
Observations: No *S. levis*

Dive name: 12-346C (Point 238)
Start time: 17:41 **End time:** 18:08
Notes: Boulders/cobbles on bottom, sloping, several rockfish, sea stars, large green spot at 17:52, fish numbers increase as transect continues
Observations:
17:53 Adult *S. levis*

Dive name: 12-346D (Point 239)
Start time: 18:55 **End time:** 19:22
Notes: Cobbles, boulders on bottom, algal covering on most surfaces, lots of rockfish, nudibranch at 19:03, a lot of particles in the water, longline at 19:09, stargazer at 19:12, 19:19 nudibranch on sponge, nudibranch at 19:21
Observations:
18:56 Adult *S. levis*

Dive name: 12-346E (Point 233)
Start time: 20:26 **End time:** 20:59
Notes: Boulders on bottom, *S. goodei* rockfish a 20:27, several small octopus, 20:31 lost everything, 20:31 transect continued, small rockfish, sandy patches, nudibranch 20:45
Observations: No *S. levis*

Dive name: 12-346F (Point 237)
Start time: 21:45 **End time:** 22:08
Notes: Sandy bottom with some pebbles and small boulders, 21:48 turns to boulders, moderate current, orange peel nudibranch at 21:53 and 22:01.
Observations: No *S. levis*

Dive name: 12-346G (Point 241)
Start time: 23:12 **End time:** 23:46
Notes: Circle of urchins around rock before transect begins, cobbles/pebbles on bottom, lots of pink urchins, small yellow corals 23:15, lots of small rockfish, sculpin at 23:27, debris at 23:28, 23:39 hake.

Observations:

23:33 Juvenile *S. levis*
23:39 juvenile *S. levis*
23:41 Adult *S. levis*

Dive name: 12-346H (Point 234)
Start time: 00:43 **End time:** 01:05
Notes: Sand bottom with some cobbles and boulders, large sea fan at 00:49:11, patches of large boulders, 00:53:33 turns primarily to boulders with patches of sand
Observations:

00:56 Adult *S. levis* (no photo)
01:03 Adult *S. levis* (in sponge)

Finished surveying San Nicolas Island. Transiting to San Clemente Island (Northwest).

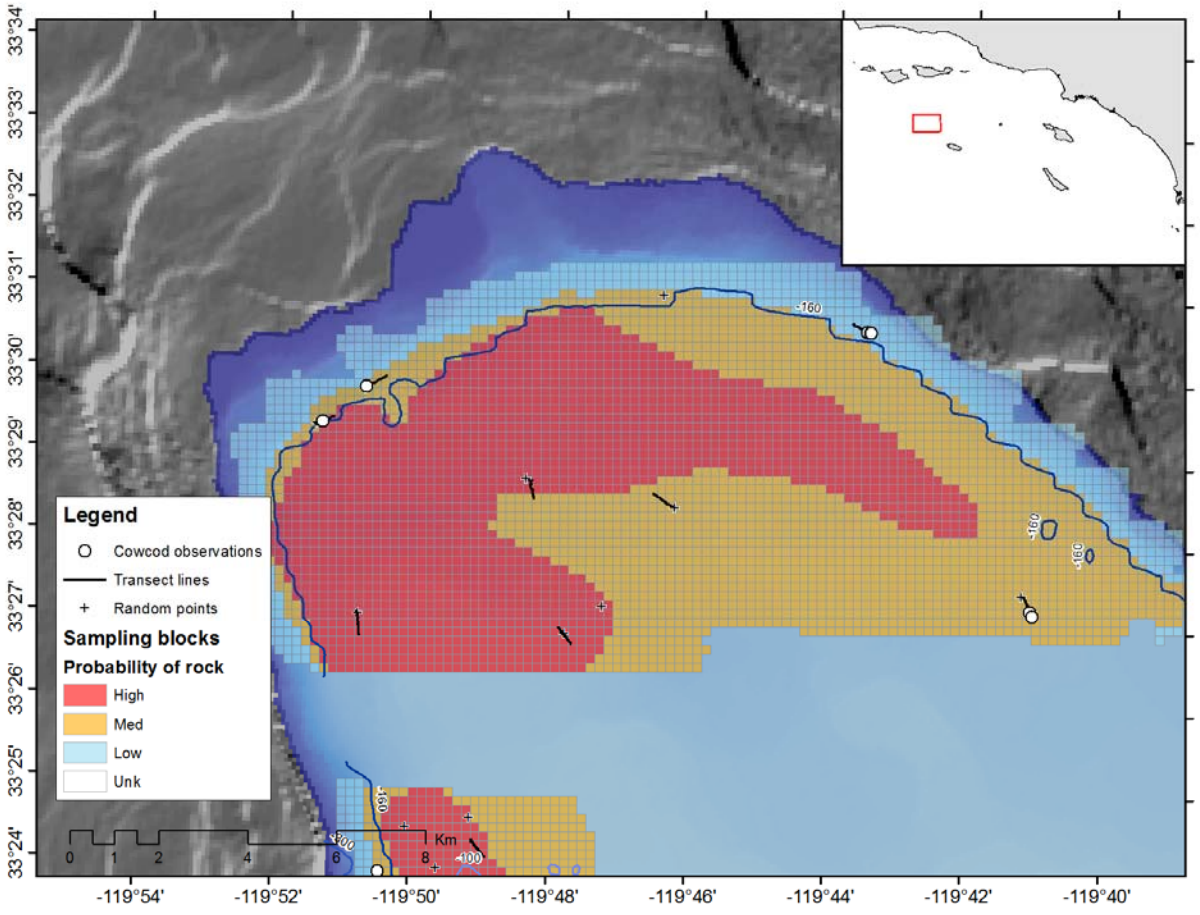

Figure 26. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from San Nicolas Island (North). A portion of the San Nicolas Island (West) survey area is visible in the bottom of the figure.

Day 24: San Clemente Island (Northwest)
12/12/2012 (Wed)

15:08-00:45 (12/12/2012) Surveyed San Clemente Island (Northwest) (**Figure 27**)

Dive name: 12-347A (Point 192)
Start time: 15:08 **End time:** 15:35
Notes: Sandy bottom, some sea stars, some crabs, 15:19 longnose ray, skates 15:21, salps 15:23
Observations: No *S. levis*

Dive name: 12-347B (Point 197)
Start time: 16:21 **End time:** 16:43
Notes: Boulders on bottom, boulders flat with lots of ledges, lots of small fish, bowl at 16:23, purple sea fans, scorpionfish at 16:27, turns to sand around 16:32, squid 16:35, 16:40 urchin eating squid, 16:42 anemone
Observations: No *S. levis*

Dive name: 12-347C (Point 196)
Start time: 17:28 **End time:** 17:45
Notes: Sandy bottom, sloping, lots of urchins and sea stars, spot prawn at 17:30, rusty cable at 17:40. Ended transect after about 250 m.
Observations: No *S. levis*

Dive name: 12-347D (Point Nonrandom)
Start time: 18:58 **End time:** 19:17
Notes: Sandy bottom with some boulders, boat light at 19:00, olive rockfish at 19:01, big *O. elongatus* at 19:02, turns to boulders at 19:02, lots of purple sea fans, lots of small fish around 19:05, coral at 19:06, cable at 19:09, fishing line at 19:11
Observations: No *S. levis*

Dive name: 12-347E (Point 195)
Start time: 20:01 **End time:** 20:19
Notes: Sandy bottom, pink surf perch at 20:02, rock with aggregation of fish at 20:08, boulder at 20:17, very little life
Observations: No *S. levis*

Dive name: 12-347F (Point 215)
Start time: 21:13 **End time:** 21:31
Notes: Sandy bottom with lots of urchins, 21:15 cat food can, some crabs and sand dabs
Observations: No *S. levis*

Dive name: 12-347G (Non-random point; 86 Fathom Bank)
Start time: 00:18 **End time:** 00:45
Notes: Rocky bottom with many overhangs, larger fish, 00:19 debris, tons of basket stars
Observations:
00:28 Adult *S. levis* in the rocks
00:29 Adult *S. levis*

Finished surveying San Clemente Island. Transiting to 60 Mile Bank.

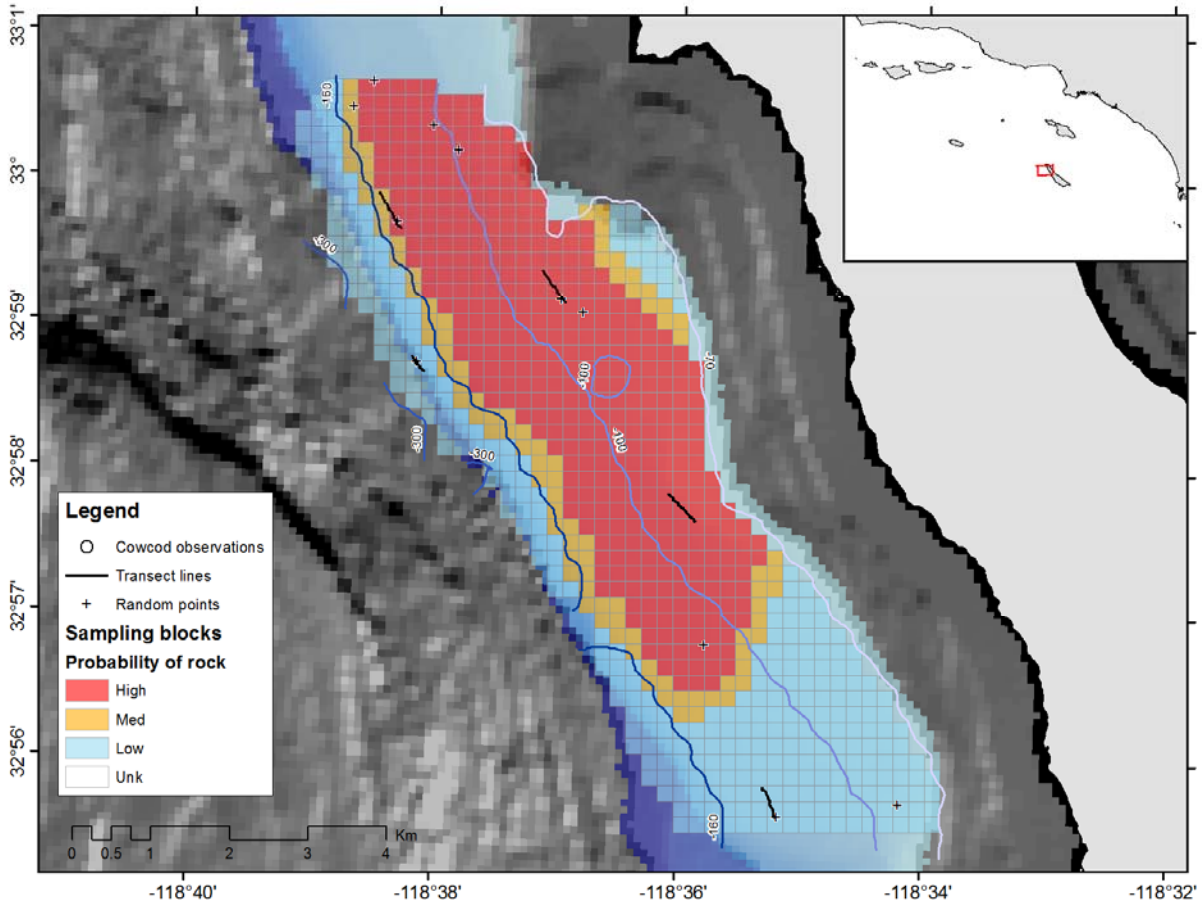

Figure 27. The location of remotely operated vehicle transects and cowcod (*Sebastes levis*) observations from San Clemente Island (Northwest).

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